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ANNUAL REPORT

FY 2014

OCTOBER 2014

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SERVIR ANNUAL REPORT

FY 2014

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Forward

SERVIR has evolved from humble beginnings, carried by a three-person staff in 2004, to its present day global reach. Over the years, we have experienced the excitement and challenges of growth and the profound sense of responsibility that comes with expanding our potential for global impact.

With this annual report, we take a step back and look at we have learned and accomplished, in particular over this past fiscal year. Successes and lessons learned help us determine next steps to ensure that SERVIR serves the greatest number of people in the best ways possible. This report illustrates the broad array of activities occurring across hubs to address multiple societal benefit areas.

The SERVIR Demand Team that joined us two years ago is now more fully integrated and coordinated with our science initiatives, enhancing SERVIR's relevance, effectiveness, and impact. This increased coordination of SERVIR demand and supply is also improving our understanding of needs and how to quantify our baseline so we can better demonstrate the impact of SERVIR activities designed to meet those needs. In addition, over the past year, we have endeavored to further integrate SERVIR Applied Sciences Team activities with both hub and Demand Team activities. This fusion of efforts helps all of us operate more effectively as One SERVIR.

My father used to say, "You are where your intention is." SERVIR team members across the globe care deeply about the work they do and intend to make a positive difference in the world. The resolve and talent of those team members and the complementary strengths of two US Government agencies continue to help SERVIR bring satellite data down to Earth -- making it accessible to and usable for the people who most need it.

Dan Irwin
SERVIR Project Director

1 Introduction to SERVIR

1.1 SERVIR Project Background

SERVIR is a joint development initiative of NASA and USAID, working in partnership with leading regional organizations around the globe, to help developing countries use information provided by Earth observing satellites and geospatial technologies for managing climate risks and land use. SERVIR's overarching goal is to help developing countries improve their environmental management and resilience to climate change.

SERVIR is working in several key Group on Earth Observations (GEO) societal benefit areas, developing tools and applications to support the needs of SERVIR regions. Using Earth observations, these tools and applications provide critical benefits to regional, national, and local decision-makers in areas such as flood forecasting, weather forecasting, agricultural productivity assessments and frost alerts, and landslide warnings.

The SERVIR Project¹ began in 2004. Working with multiple partners in the developing world, SERVIR co-develops new tools and capacities to use climate information for adaptation and resilience, sustainable landscapes, and related GEO societal benefit areas. SERVIR makes satellite data, mapping tools, and decision support applications available via a publicly-accessible Web-based platform.

In 2005, the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC) in Panama became the first regional SERVIR center, or "hub," serving Central America and the Dominican Republic. It operated from 2005-2011 funded via SERVIR and now continues to operate independently, still drawing on SERVIR-developed data, tools and services.

In late 2008, a SERVIR hub at the Regional Center for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya, was dedicated to serve East Africa. Another SERVIR hub was inaugurated in October 2010 in cooperation with the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal, for the Hindu Kush-Himalaya (HKH) region of Asia.

Each hub operates within existing regional institutions that have political buy-in from member countries in the region, and each has a team of local specialists with expertise in remote sensing, geographic information systems (GIS) mapping, and database management.

SERVIR partners with more than 70 different organizations in these regions to bring satellite data and geospatial technology to bear on environmental issues around the globe. SERVIR activities touch or have touched 38 countries: 9 in Central America, 19 in Africa, 5 in the HKH region, and 5 in the Lower Mekong region of Southeast Asia. Since its inception, SERVIR has created many different decision support tools and applications for use in the hub regions. At this time, end users are wielding 43 different SERVIR products to issue flood early warnings, generate frost alerts, detect and monitor forest fires, map biodiversity, predict agricultural drought, and much more. These tools and applications use data from 22 different Earth observing satellites and sensors. (See the appendices for more information on the SERVIR Project Portfolio Use of Satellite Data.)

¹USAID refers to SERVIR as a program and NASA considers it a project. This report refers to SERVIR as a project.

1.2 SERVIR Project NASA Activity

While SERVIR focuses heavily on the latest in science and technology, it is ultimately a capacity building project. SERVIR's overarching goal is to help developing countries improve their environmental management and resilience to climate change. To achieve this goal, SERVIR strives to strengthen the capacity of governments and other key stakeholders to integrate Earth observation information and geospatial technologies into development decision-making. This objective combines the strengths of both USAID and NASA, as USAID brings its expertise and experience working within the context of developing countries to help determine the demand for the kind of Earth science and technology expertise NASA offers. To achieve these objectives, a list of common goals was established jointly between NASA and USAID. These goals are shown in Table 1.



































































Table 1. SERVIR Near-Term Common Goals

Goal #	Goal Description
Goal 1	Provide knowledge management and quality assurance enabling online access to high quality geospatial information, products, and data (including information, products and data that are not generated by SERVIR) and distributing user-tailored tools and applications.
Goal 2	Create and adapt user-tailored tools and applications (e.g., for disasters).
Goal 3	Strengthen and contribute to the technological capacity, scientific capacity, and other capacities (e.g., management, evaluation, financial, governance, organizational etc.) of the regional hubs so the hubs can provide geospatial data, tools, models, and applications to decision-makers in the long term.
Goal 4	Ensure that SERVIR adds value and harmonizes the SERVIR mission with the strategic mission of the host institution so that services are provided into the future.
Goal 5	Build capacity and desire to use geospatial data to influence and make informed decisions for national governments and other stakeholders.
Goal 6	Foster the sharing of technical applications, data and knowledge across the network.
Goal 7	Encourage free and open data and product exchange in regional hubs and countries.
Goal 8	Enable access to in situ data that improves and informs earth science observation models
Goal 9	Strengthen the evidence base about the development and environmental impact of SERVIR on decision-making including cost vs. benefit, and lessons learned.
Goal 10	Share knowledge about effectively developing and delivering user-tailored climate services

Table 2 (on the next page) depicts the current alignment of FY 2014 deliverables with SERVIR, USAID, and NASA strategic goals based on the deliverables planned for FY 2014-15².

² As of this writing, the hubs are in the process of updating their work plans and associated deliverables. As annotated, Table 2 takes into account several anticipated deliverables that are not currently in the baseline plan.

Table 2 Weighted Matrix Depicting Deliverables Aligned to Goals through 2015

USAID/NASA Strategic Goals SERVIR Unique	USAID Strategic Goals			NASA ASP Goals		
	SO 1. Accelerate the transition to low emission development through investments in clean energy and sustainable landscapes	SO 2. Increase resilience of people, places, and livelihoods through investments in adaptation and	SO 3. Strengthen development outcomes by integrating climate change in Agency programming, learning, policy dialogues and operations	STRATEGIC GOAL #1. Enhance Applications Research: Advance the use of NASA Earth science in policy making, resource management and planning, and disaster response.	STRATEGIC GOAL #2. Increase Collaboration: Establish a flexible program structure to meet diverse partner needs and applications objectives.	STRATEGIC GOAL #3. Accelerate Applications: Ensure that NASA's flight missions plan for and support applications goals in conjunction with their science goals, starting with mission planning and extending through the mission life cycle.
Goal 1 Provide knowledge management and quality assurance enabling online access to high quality geospatial info, products, and data (including info, products and data not generated by SERVIR) and distributing user-tailored tools and applications.						
Goal 2 Create and adapt user-tailored tools and applications (e.g., for disasters).						
Goal 3 Strengthen and contribute to the technological capacity, scientific capacity, and other capacities of the regional hubs so the hubs can provide geospatial data, tools, models, and applications to decision-makers in the long term.						
Goal 4 Ensure that SERVIR adds value and harmonizes the SERVIR mission with the strategic mission of the host institution so services are provided into the future.						
Goal 5 Build capacity and desire to use geospatial data to influence and make informed decisions for national governments and other stakeholders.						
Goal 6 Foster the sharing of technical applications, data and knowledge across the network.						
Goal 7 Encourage free and open data and product exchange in regional hubs and countries.						
Goal 8 Enable access to (use of) (1) in situ data that improves and informs Earth science observation models.						
Goal 9 Strengthen the evidence base about the development and environmental impact of SERVIR on decision-making including cost vs. benefit and lessons learned.						
Goal 10 Share knowledge about effectively developing and delivering user-tailored climate services.						
Legend: Planned SERVIR Interfaces with Agency goals						
	Significant Activities Planned >11	Many Activities Planned 6-10	Some Activities Planned <5	No Activities Planned	NOTES: 1. Assuming the use of data, not just access to the data. (need JCP approval for change to wording) 2. Assumes planned AST tasks + GPM Val tasks being approved for work plan	

1.3 SERVIR Results Framework

The SERVIR Results Framework (Figure 1) has remained the same during the past year. It outlines USAID's and NASA's approach to the overall project and illustrates the complementary relationships between the supply and demand elements. Numerous activities and initiatives are being supported at the existing hubs with the direct support of NASA to reach the US Government's goal of improved environmental management and climate change resilience. Although the Supply Activity is an important piece of the SERVIR Project, it is not the only activity contributing to SERVIR goals and objectives.

(See the Appendices for a performance monitoring table that lists SERVIR FY 2014 planned vs actual totals for the Results Indicators given in this framework.)

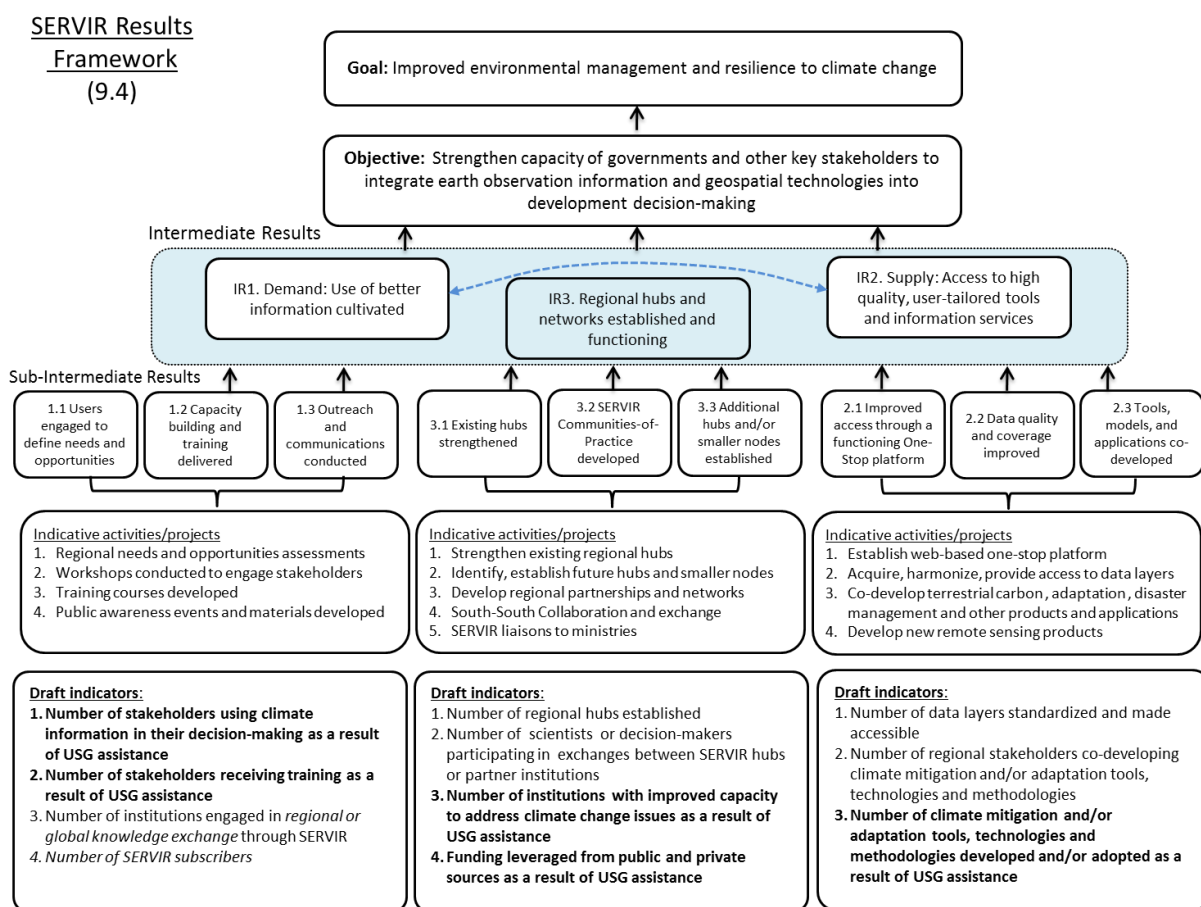


Figure 1. SERVIR Results Framework

2 Scope of this Document

This annual report documents recent SERVIR successes in general as well as achievements and challenges specific to FY 2014 and new opportunities that arose during the fiscal year. Narrative discussions in the body of this document address the key highlights, and tables in the appendices present more information. The appendices include the SERVIR Organizational Chart, a listing of satellite sensors used by SERVIR applications and projects, geographic extent maps for the science applications, a listing of FY 2014 deliverables, and the performance monitoring table.

3 Overview of Key SERVIR Successes

This section describes recent SERVIR successes. Some of these milestones represent work that was initiated prior to last year, but refinements to and/or expansion of all of the below occurred in FY 2014.

Sections 4.1 and 5.1 give the details about FY 2014-specific activities.

- The JASON-2 FLOOD EARLY WARNING SYSTEM tracks river levels far upstream and across borders to predict where and when flooding will occur downstream, enabling the Flood Forecasting and Warning Center in Bangladesh to generate flood forecasts eight days in advance as opposed to the three days provided by their previous system. Lack of international data sharing has made flood forecasting a major challenge for Bangladesh, but satellite data overcomes this challenge by providing a “virtual water level station.” Jason-2’s radar altimeter measures the precise distance between the satellite and the river surface at points where the satellite crosses overhead. The data, available almost immediately, reveals the river’s height at the point of crossing, so flood risks downstream can be assessed. (See section 5.1.3 for details about FY 2014 achievements of this project.)
- The CREST FLOOD FORECASTING SYSTEM serves watersheds in Eastern and Southern Africa. CREST, short for Coupled Routing and Excess Storage, is a model that uses rainfall data from NASA satellites to assess streamflow-- the volume of water that moves over a point in rivers and streams over a fixed time. The SERVIR system monitors streamflow by using real-time satellite rainfall data and forecasts from the Kenya Meteorological Service (KMS) and produces information about current and forecasted flooding for national water resources departments for potential action. The CREST STREAMFLOW VIEWER graphically presents, via web maps and time series plots, this modeled information on precipitation and streamflow for assessment of flood potential. SERVIR-Eastern and Southern Africa (SERVIR-E&SA) customized an ESRI ArcGIS extension tool to map the extent of floods. This tool uses as inputs the streamflow estimations generated through CREST. SERVIR-E&SA provided training for and implemented (1) the CREST model for streamflow estimations and (2) the use of the flood mapping tool in several African countries, enabling decision-makers in those countries to run the models on their own. In addition, CREST encourages data sharing between ministries in African countries, helping agricultural, water, and hydropower authorities with irrigation, permitting, and planning, respectively. (See sections 5.1.3 and 5.1.5 for details about FY 2014 achievements of this project.)
- The FROST FORECASTING TOOL alerts farmers in Kenya when frost is imminent, giving them a chance to protect their tea crops. This tool was developed in collaboration with the Agricultural Ministry as well as a regional Tea Research Foundation, and has enabled these organizations to serve farmers with actionable information. It has also helped create a new market for crop insurance companies, which are exploring ways to provide products that help tea farmers reduce losses. (See section 5.1.1 for details about FY 2014 achievements of this project.)
- The FOREST FIRE MONITORING AND DETECTION SYSTEM detects and monitors wildfires in Nepal and Bhutan and sends alerts to Forestry Department officials’ mobile devices. The system uses data from the Moderate-resolution Imaging Spectroradiometer (MODIS) on NASA’s Terra and Aqua satellites to identify wildfire location, and broadcasts email and text message alerts within 20 minutes of detection, enabling officials to warn villagers of imminent danger. In addition to helping district forest managers respond to fires, this tool assists the Forest Department in understanding changing fire patterns. (See section 5.1.3 for details about FY 2014 achievements of this project.)

- The LAND-COVER MAPPING FOR GREENHOUSE GAS (GHG) EMISSIONS project has developed land cover and land use maps with ground validation in collaboration with forestry departments in six African countries – Malawi, Botswana, Tanzania, Namibia, Rwanda, and Zambia. (Botswana, Tanzania, and Namibia were completed in FY 2014, the other three countries in FY 2013). Land use/land cover changes, due primarily to deforestation, contribute about 20% of GHG emissions in Africa, so it is important to track these changes and corroborate them on the ground through validation efforts. SERVIR-E&SA trained and worked with end users and collaborators in forest departments and environmental ministries to generate Landsat-derived land cover maps for use in GHG emissions inventories. The maps are generated with specific attention to regional forest types and land cover classes as identified by national governments, at the same time harmonizing those classes with Intergovernmental Panel on Climate Change (IPCC) Tier-1 categories to enable those countries to submit the Third National Communication on GHG emissions inventory.
 - The datasets are available for download at <http://servirportal.rcmrd.org>.
 - For the Map Service, visit <http://servir.rcmrd.org/ArcGIS/rest/services/landcover>
 - The visualization tool, available at: <http://servir.rcmrd.org/geoapps/landcoverviewer/>, can compare land cover from different years and schemes of classification.

Land cover mapping began during FY 2014 in three additional countries – Ethiopia, Mauritius, and Uganda. (See section 5.1.2 for further details about FY 2014 achievements of this project.)
- The INTERNATIONAL SPACE STATION SERVIR ENVIRONMENTAL RESEARCH AND VISUALIZATION SYSTEM (ISERV), operating since early 2013 onboard the ISS, has taken thousands of pictures of Earth and is being used to support disaster response, humanitarian relief efforts, adaptation to climate change, and environmental management. For example, ISERV images revealed the devastation caused by floodwaters in Calgary 22-24 June 2013, in the Indian state of Uttarakhand 26 June 2013, and on the Russia/China border in September 2013. Achievements during FY 2014 included images of the burn scar from a Valparaiso, Chile wildfire that occurred 12 April 2014, and photos of the scar left by an EF-4 tornado in Louisville, Mississippi, 28 April 2014. In many cases, such ISERV imagery is made available for the International Disasters Charter (IDC) (<http://www.disasterscharter.org/web/charter/home>). Also, ISERV answered the call during FY 2014 from NASA and USAID to serve developing countries by providing observations of their regions from space. (See sections 4.1 and 5.1.3 for details about ISERV achievements.)
- The SATELLITE-BASED AGRICULTURAL DROUGHT EARLY WARNING SYSTEM compares recent vegetation data to historical data to indicate whether crop yields for the current year will be greater or lower than average in Nepal. Assessments of potential agricultural yields are performed at district and Village Development Community (VDC) levels for Nepal's Ministry of Agricultural Development and the World Food Program (WFP). Monitoring agricultural fields in this way alerts officials of potential shortages so that appropriate measures can be taken for avoiding famine. The information also helps decision-makers determine whether current farming practices are producing optimal crop yields or instead need to be modified. (See section 5.1.1 for details about FY 2014 achievements of this project.)
- The IMPROVING KENYA METEOROLOGICAL SERVICE NUMERICAL WEATHER PREDICTION project brings NASA Earth observation satellite-derived datasets to bear on regional forecasting accuracy in Eastern Africa. This application strengthens KMS numerical weather prediction capabilities and increases the accuracy of weather forecasts in the region. In

turn, improvements in weather forecasting are enhancing flood, drought, and frost forecasts. (This project is a collaboration with the KMS in atmospheric modeling and verification using the Weather Research and Forecasting (WRF) model.) (See section 5.1.3 for details about FY 2014 achievements of this project.)

4 FY 2014 Achievements, Opportunities, and Challenges

This section gives a general summary of SERVIR FY 2014 achievements that are detailed later, in section 5. This section also lists SERVIR strengths, weaknesses, opportunities, and threats.

4.1 FY 2014 Achievements

As outlined and discussed in the annual work plan update issued in June of 2014, SERVIR hub science activities this past year (1) established a firm foundation for developing planned tools and applications to best meet end user needs and (2) developed regional capacity for using these assets. Important activities included stakeholder consultations and training workshops as well as data gathering and analysis. Through SERVIR consultations with current and potential end users, SERVIR team members (1) assessed existing levels of knowledge, tools, data, and skills for implementing and using SERVIR applications that are under development, (2) honed in on specific needs in each of these areas, and (3) identified community-based priorities. Training workshops developed capacity – knowledge, skill, etc. – in hub regions for using the tools and applications and applying them in decision-making. During FY 2014, SERVIR trained 427 people from 35 institutions. Also this fiscal year, datasets critical to the applications were compiled and analyzed and models were developed and validated. Section 5.1 of this report details these achievements.

SERVIR's ISERV camera on the International Space Station (ISS) also contributed science-related achievements in FY 2014. To date, ISERV has acquired over 150,000 images of Earth, including critical disaster photos, many of which were made available to the IDC for use in disaster response and assessment. ISERV also captured targets of interest in SERVIR hub regions in response to requests from USAID. The ISERV team won a 2014 NASA Group Achievement Award for pioneering the use of an ISS-borne camera for disaster imaging. In addition, Jaganathan Ranganathan of the ISERV team received this year's Marshall Space Flight Center Science and Technology Office's Peer Award for Innovation for developing a novel automated data georeferencing technique. The method provides very good positional accuracy and operates up to 20X faster than manual processing, allowing ISERV's photos of the Earth's surface to be posted online much faster. And with the new ISERV data viewer developed in FY 2014, users can easily find the images they seek. ISERV end of operations on the ISS is scheduled for 17 November, but the system will be stowed and ready for deployment as a payload of opportunity through Q2 of FY 2015. ISERV will continue to process and publish data through May 2015. Section 5.1.3 details ISERV-related FY 2014 achievements.

In the area of technology capacity building, a SERVIR Geospatial Information-Technology (GIT) Boot Camp was hosted by the Coordination Office (CO) in March. Twenty-five people participated from SERVIR-E&SA, SERVIR-Himalaya, SERVIR-Mesoamerica, and the CO. Topics covered included data management best practices and upgrading to the newest software and IT platforms. The event also marked the beginning of a SERVIR GIT Community of Practice and introduced cloud-infrastructure management concepts and procedures to the international SERVIR team. GIT experts from RCMRD and ICIMOD have begun to share ideas to accelerate development of applications. Section 5.2 discusses these achievements as well as other SERVIR capacity building achievements, including youth programs, national geospatial portals, small-scale applications, and more. In the area of Core Infrastructure and

Regional System Implementation, the CO assisted the regional hubs in Eastern & Southern Africa and the Himalayas in acquisitions of Geospatial IT infrastructure. Section 5.3 gives more details.

For Communications and Outreach, 70 stories were written and posted on SERVIRGlobal.net highlighting milestones, successes, and events during the year. In addition, support was provided for product catalog content, multimedia development, and new SERVIR website planning and development. Connections were established among the CO communications lead, Demand Team communications lead, and hub communications leads to encourage team work and exchange of information as well as enhance consistency of communications materials in terms of style, format, and messaging. Section 5.4 lists more FY 2014 Communications and Outreach activities.

In the area of Project Management, the first annual Joint Working Group (JWG) meeting was held between the two agencies, and the annual Performance Management Plan (PMP) and Work Plan were updated and released. In the interest of SERVIR Project Support over the course of the year, the SERVIR team supported or held a number of key exchanges, meetings, and reviews. Details for Project Management and Project Support are given in section 5.5.

Appendix E, a performance monitoring table, is a listing, by indicator, of FY 2014 accomplishments and the resultant indicator numbers achieved vs the number targeted.

4.2 FY 2014 Situational Analysis – Key Strengths, Weaknesses, Opportunities, and Threats

As SERVIR expands during 2014-2020, the project's strategy will take advantage of external opportunities to strengthen and build SERVIR. At the same time, SERVIR leadership will develop a strategy to overcome and mitigate the project's external threats and challenges.

Critical opportunities include framing the SERVIR Project within the context of the USAID resilience agenda. In addition, there is a growing focus on open data for climate services in the US and internationally (e.g., the White House Climate Initiative and the World Bank Global Framework for Climate Services) that SERVIR can take advantage of to garner political support. There are also opportunities to make SERVIR tools and products more competitive by leveraging advances in mobile technology, social media, crowd-sourcing, and demands for data analytics. Finally, specific assets within each agency – such as the USAID Global Development Lab and new satellite data capabilities at NASA – present important opportunities that SERVIR will take advantage of during the next five years.

SERVIR leadership will consider a new organizational structure to make it easy for other organizations to contribute funding and other resources. In addition, an important challenge to the project is the complexity of the management structure. SERVIR leadership will mitigate this challenge by defining clear roles and responsibilities for USAID and NASA in terms of management, technical oversight, planning, and reporting.

Key strengths, weaknesses, opportunities, and threats of the SERVIR Project are listed below. As USAID and NASA look to strengthening, managing, and expanding the project from 2015-2020, it will be important for SERVIR leadership to review this Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis and reflect and act, as needed.

Strengths

- A strong USAID-NASA partnership that has been active, continuous, and funded since 2004
- High level agency visibility, popularity, and support at USAID and NASA
- Strong brand equity

- High functioning hubs that are leaders in their regions
- Long-term relationships with key influencers in the US (via NASA and USAID) and in the developing world (via SERVIR hub institutions)
- Local institutional capacity development approach (SERVIR hubs and government stakeholders)
- Scientific expertise from NASA funded projects, directly or leveraged
- Development expertise from USAID
- Global networks via hubs, NASA and USAID
- Passionate leadership and a committed team
- Scientific recognition of NASA and hubs eases accessibility to users in the region

Weaknesses

- Complex, decentralized management structure with a large group of global partners
- Challenge working with two federal institutional cultures
- Need to better integrate supply and demand technical assistance
- Unclear long-term strategy for hub expansion
- Shifting contract and management mechanisms with existing hubs (from NASA to USAID)
- Unclear mechanism and approach for working with countries not covered by SERVIR hub
- NASA information technology security sensitivities
- Need to better demonstrate and communicate SERVIR results

Opportunities

- Advances in mobile technology, social media, and crowd-sourcing
- Growing focus on open data and climate data in the US, e.g., White House Climate Initiative, White House high resolution elevation data initiative, and the World Bank Global Framework for Climate Services
- USAID geographic and thematic priorities that resonate with SERVIR (e.g., focus on resilience in W/E Africa and Asia)
- Collaboration with Global Forest Watch (GFW) by providing regional forest products to potentially improve the accuracy of GFW products
- Collaboration with USAID Global Development Lab
- Need for data analytic and visualization services
- USAID resilience agenda complementary to SERVIR
- New satellite data capabilities, such as Global Precipitation Measurement (GPM), Soil Moisture Active-Passive (SMAP), etc.

Threats

- Lack of coordination and potential duplication with other US Government (USG) agencies, multilateral partners, and the private sector
- Funding uncertainties and unclear future USG budget climate
- Current sustainability structure of SERVIR makes it difficult for the project to attract funding
- Unstable political environments in countries where SERVIR operates
- Travel restrictions to African region

5 Results

This section details FY 2014 achievements and progress for FY 2014.

5.1 Science-Based Results

SERVIR science applications and projects for FY 2014 focus on five themes or categories: (1) agriculture and food security, (2) ecosystems and sustainable landscapes, (3) disasters, (4) air quality, and (5) water resources and cryosphere. This section of the annual report describes SERVIR's progress in these thematic areas for FY 2014. It should be noted that the CO is promoting AST-hub collaboration in these thematic areas through sister projects and small scale applications.

The maps in Appendix C show the geographic extent of each project.

5.1.1 Agriculture and Food Security

This section describes SERVIR applications designed to mitigate the impacts of climate change on agriculture and food security in SERVIR hub regions.

SERVIR-Himalaya

- SERVIR-Himalaya is developing a Satellite-based Agricultural Drought Early Warning System that compares recent vegetation growth data to historical data to indicate whether crop yields for the current year will be greater or lower than average in Nepal. Monitoring agricultural fields alerts officials of potential shortages so that appropriate measures can be taken for avoiding famine. The information, provided in the form of online maps and data, will help decision-makers determine whether current farming practices are producing optimal crop yields or instead need to be modified. Key FY 2014 activities are listed below.
 - Stakeholder consultations and workshops were held to gather information on existing mechanisms for drought early warning systems and assess the situation for the development of a new, comprehensive tool that meets end user needs, with scalability for application to additional countries/regions.
 - SERVIR-Himalaya developed a project, at the request of the Nepal Ministry of Agricultural Development (MoAD), to link MODIS-derived Normalized Difference Vegetation Index (NDVI) data for the past 12 years to Nepal Agricultural Statistics field data, and based on this analysis completed fortnightly crop drought indicator maps.
 - Long-term, spatially explicit agricultural records have been compiled into a database to display in an atlas, and user-friendly web applications are being developed to allow decision-makers and researchers to easily put this research to use.
 - Together, the atlas and the drought early warning system will serve as a basis for food security analysis and planning.
- SERVIR-Himalaya is also developing a Rangelands Decision Support System (DSS) for the HKH Region of Pakistan using MODIS-based in-season rangeland growth dynamics for the region. The intent is to optimize grazing plans/schedules through pilot study-based understanding of rangeland growth calendar, productivity, trans-humance migration patterns, and socioeconomic levels. Key FY 2014 activities are listed below.
 - Toward development of this tool, SERVIR-Himalaya held a stakeholder consultation in 2014 in Islamabad, Pakistan, to assess current knowledge on rangelands in Pakistan, identify needed elements of a DSS for rangelands management, note potential collaborations, and accommodate easy scalability. Among the attendees were the Director General of Pakistan Forest Institute and the Director General of Mountain Agriculture Research Center.

- Ecological classification and phenological cycles of rangelands in the mountain region of Pakistan were completed as well as compilation of 11 years' worth of MODIS vegetation indices baseline data for onward monitoring of rangelands forage conditions.
- Work continues toward creation of the tool in late 2014 and its operationalization, launch, and dissemination in collaboration with end users and partners in 2015.

SERVIR E&SA

- In collaboration with the SERVIR Applied Sciences Team (AST), SERVIR-E&SA is implementing a system to improve regional capabilities in drought forecasting and crop yield forecasting. Ministries of Agriculture and other food security agencies need reliable information in order to plan for surpluses or deficits. SERVIR AST Principal Investigator (PI) Stephanie Granger of NASA's Jet Propulsion Laboratory (JPL) leads a project called East Africa Drought and Agricultural Productivity Assessment and Prediction System. The aim is to link drought and crop productivity nowcasts and forecasts for Kenya, Ethiopia, Tanzania, and Uganda through implementation of a modeling framework consisting of a hydrologic model (variable infiltration capacity, or VIC) coupled with a crop productivity model called Decision Support System for Agrotechnology Transfer (DSSAT). SERVIR-E&SA/RCMRD plays a role through its Crop Monitoring and Yield Forecasting sister project. Key FY 2014 activities are listed below.
 - Granger completed the maize model for DSSAT. As inputs for the model, which estimates maize crop yield, she used a subset of an unprecedented 30-year daily rainfall time series grid for the African continent created by AST member Jim Verdin of the US Geological Survey (USGS) and his associates. With the help of SERVIR-E&SA's Eric Kabuchanga, a web interface was created and activated for accessing this Climate Hazard Group InfraRed Precipitation with Station (CHIRPS) data via the RCMRD web portal. (CHIRPS is the first spatially and temporally continuous rainfall dataset. It is high-resolution global data.)
 - SERVIR-E&SA Disaster Lead Denis Macharia and staff from Department of Resource Surveys and Remote Sensing (DRSRS) (Kenya) attended a DSSAT training workshop in Griffon, Georgia, USA in May 2014. Macharia has since been training fellow RCMRD staff members in the use of DSSAT.
 - Datasets for different weather parameters such as solar radiation and evapotranspiration are being generated as part of this project. The datasets are calibrated and validated and will become a part of the products.

Through the sister project:

- Historical crop yield data and meteorological data were gathered for Uasin Gichu, Eldoret, Kenya, where the system is being piloted and tested.
- RCMRD/SERVIR-E&SA is supporting the AST team in collecting ground observations of weather data, crop yield, and drought indicators.
- RCMRD/SERVIR-E&SA hosted a Drought and Crop Productivity Inception Workshop and Technical Exchange Meeting in March 2014, led by Granger. The workshop introduced this project to relevant ministries and local research organizations and was a venue for gathering data and technical needs recommendations to guide development of an upscalable system.
- The drought and crop productivity modeling system is planned for transfer next year to disseminate and explain the functionality of the DSSAT system to the Ministries of Agriculture and government agencies.

- SERVIR E&SA's Frost Forecasting and Mapping System provides information to farmers in Kenya when frost is imminent, giving them a chance to protect their tea crops. This tool was developed in collaboration with the Agricultural Ministry in Kenya as well as the Tea Research Foundation of Kenya (TRFK), and has enabled these organizations to serve farmers with actionable information. It has also helped create a new market for crop insurance companies, which are exploring ways to provide products that help tea farmers reduce losses. Key FY 2014 activities are listed below.
 - SERVIR-E&SA worked with the SERVIR CO in developing and installing a wireless sensor network (WSN) for frost monitoring in Kericho, Kenya.
 - They are now calibrating the Frost Forecasting and Mapping System and monitoring frost conditions by using MODIS satellite observations, KMS WRF forecasts, and the WSN data.
 - They are also focusing on disseminating the system to end users, and will hold training workshops to build capacity for TRFK end users to operate it.
 - They will lay the groundwork in FY 2015 to expand use of the system to Tanzania, Ethiopia, and Uganda.
- Land Potential and Knowledge System (LandPKS) is a data collection and dissemination system to aid in both land use planning and agricultural/conservation extension activities. SERVIR-E&SA's Land PKS project aims to provide an estimate of the best use of the land, optimizing for both agricultural/livelihood production and long-term landscape resilience in Namibia, Kenya, and Tanzania. The project is being initially piloted in northern Namibia and then will be piloted more extensively in northern Kenya and Tanzania. RCMRD is working closely with USDA-ARS (US Department of Agriculture - Agricultural Research Service) to move from a traditional land potential management system to one which incorporates local knowledge with broader global datasets on soil, water, land cover, biodiversity, and climate change. The idea is to create a knowledge base that will grow and improve with time as new information flows into the system. RCMRD/SERVIR-E&SA is facilitating data collection and GIS analyses. Key FY 2014 activities are listed below.
 - Data collection is complete and GIS analysis of the data is nearing completion.
 - Development of the model and a mobile app are ahead of schedule and nearing completion and should be ready by February 2015. They will be rolled out via a training workshop.

SERVIR CO

- To support SERVIR-E&SA's Frost Forecasting and Mapping System project, the SERVIR CO developed WSNs to better identify frost conditions by collecting temperature, wind speed, and humidity observations locally at deployment sites and using that information with the forecasts and satellite data products. In doing this, SERVIR CO developed a frost algorithm for a Huntsville WSN test network for potential application to Kenya once frost is sufficiently observed there and data on these events and past frosts can be analyzed. The data from the WSN is intended to augment the MODIS-derived land surface temperature (LST) products served by SERVIR-E&SA. SERVIR-E&SA has sponsored training workshops and will continue to train regional officials in the use of the frost products to inform farmers. SERVIR-E&SA and CO used insights from a SERVIR / My Community Our Earth (MyCOE) project at SERVIR-E&SA/RCMRD to help define requirements and co-develop the frost forecasting. (See section 5.2.4 for more information on MyCOE.)

- SERVIR CO development of a Prototype Web-based Geoprocessing Tool beta version is nearing completion. The USAID Bureau of Food Security expressed a need for a simple web-based tool for measuring areas under productive agricultural use in Africa, in particular Senegal. Because NDVI provides a proxy for agricultural productivity by showing photosynthetic activity, SERVIR is developing a tool to allow for interpretation of daily and seasonal NDVI over a selected historical time period for a selected area. This tool will allow USAID and the US Government to observe the effectiveness of different on-farm measures for boosting growing area or duration, as well as to compare treatment and non-treatment areas. In addition to NDVI data, this tool will offer similar interpretation for a rainfall data product called CHIRPS, which was developed as part of a SERVIR AST project and was an essential input to assess the impacts of climate variability on agricultural production as well as to monitor the effectiveness of current farming measures. (As mentioned above, CHIRPS is the first spatially and temporally continuous rainfall dataset. It is high-resolution global data.)

5.1.2 Ecosystems and Sustainable Landscapes

Greater attention to ecosystems mapping is key to detecting, monitoring, understanding, and forecasting the consequences of global pressures such as climate change and land use change. This section describes SERVIR applications designed to support activities in this thematic area.

SERVIR-Himalaya

- To provide a platform that can show a complete picture of natural resources, including historical information, with integration of field information and social dynamics, SERVIR-Himalaya is implementing a project called Biomass Estimation using Multi-resolution Satellite Data at Sub-national Level. A Web-enabled monitoring system is being developed to support mechanisms linked Reducing Emissions from Deforestation and Forest Degradation (REDD) Measurement, Reporting, and Verification. It will provide (1) periodic monitoring of biomass estimates, which are inputs into carbon monitoring, over REDD sites, (2) a crowd-source-based monitoring system, and (3) REDD project specific data preparation and assessment tools. Key FY 2014 activities are listed below.
 - Stakeholder consultations and workshops were held over the past year to identify potential collaborations and work out a standardized design for biomass estimation.
 - SERVIR-Himalaya held an International Expert Group Meeting on Biomass Assessment and Monitoring in the Hindu Kush-Himalayan Region in December 2013. Advancements in biomass assessment and monitoring were discussed, and geospatial and forestry experts in attendance brainstormed about geospatial data and techniques for accurate estimation of biomass and carbon.
 - A training course called Deforestation and Forest Degradation Mapping and Monitoring using Multi-scale Geospatial Methods in context of REDD+ Initiatives was held at ICIMOD Headquarters, Kathmandu, Nepal, 4-8 August 2014, to impart remote sensing knowledge and techniques for monitoring forest cover and associated biomass.
 - Field data on forest canopy and biomass was gathered for districts with limited data availability.
 - A cost-effective methodology was developed to estimate biomass and carbon stock using very high to medium resolution satellite images (from the watershed to district level) integrated with field measurements.
 - A web-based system is being developed to publish biophysical (canopy layer, leaf area index, etc.) and social (population, livelihood, dependency, etc.) datasets. This publicly

- available system will allow users to monitor deforestation, forest degradation, and biomass changes over a certain time period.
 - The study has been carried out in close collaboration with Ministry of Forest and Soil Conservation and other stakeholders in Nepal.
 - Next steps include stakeholder engagement for launch.
- Another SERVIR-Himalaya project for this thematic area is called Climate Change Vulnerability and Adaptation Strategies of Forest Ecosystems of Chitawan Annapurna Landscape (CHAL) of Nepal using Geospatial Approaches. Key FY 2014 activities are listed below.
 - SERVIR-Himalaya compiled data on demographics, climates, and local demands on ecosystems to map forest vulnerability and sensitivity zones.
 - Stakeholder consultation meetings were held to discuss (1) challenges of assessing climate change related vulnerabilities of forest ecosystems in CHAL and the challenges of creating adaptation strategies, considering these vulnerabilities; (2) tool development; and (3) possible collaborations.
 - Geospatial tools will be useful for natural resources planning under different vulnerability scenarios.
- SERVIR-Himalaya is also working on an application called Automated Forest Cover Monitoring of Hot Spots using LANDSAT TM 8 data. Such a system is needed to provide periodic monitoring of the HKH region to identify "hot spot" areas in danger of deforestation and in need of critical forest management attention. Key FY 2014 activities are listed below.
 - National and regional consultation workshops were held involving countries in the HKH region to develop consistent and harmonized regional temporal land cover databases and to discuss the system, which will first be developed for a pilot site and then upscaled to a national level.
 - Decadal land cover change assessments for 1990, 2000, and 2010 were analyzed for Nepal, Bhutan, and HKH regions of Pakistan and Bangladesh to determine forest cover and select hot spots.
 - These datasets were also made available through web mapping applications that feature query and visualization tools.
 - ICIMOD has been engaging in conversations with GFW to identify areas where SERVIR products, generated with local and regional collaborations, can add value to the GFW initiative's global suite of products.

SERVIR-E&SA

- For the GHG Land Cover Mapping project, starting in 2013, SERVIR-E&SA supported six African countries -- Malawi, Rwanda, Zambia, Namibia, Botswana, and Tanzania -- in GHG emissions inventory by generating Landsat-derived Land Cover/Land Use (LCLU) maps in close consultation with end-users in forest departments and environmental ministries. (Botswana, Tanzania, and Namibia were completed in FY 2014, the other three countries in FY 2013). The LCLU mapping is expanding, beginning during FY 2014 in three additional countries – Ethiopia, Mauritius, and Uganda. Consistent maps of LCLU are critical to the accuracy of emissions inventories. The SERVIR-E&SA-produced maps feed into a broader United Nations Framework Convention on Climate Change (UNFCCC)-US Environmental Protection Agency (EPA) project to quantify the GHG inventory. Key FY 2014 activities are listed below.
 - With RCMRD, SERVIR-E&SA has been holding workshops in the six countries to spread the word about the availability of these richly informative maps and to launch the LCLU

visualization tool, which will support better land use planning and management in Eastern and Southern Africa. For example, there was a workshop in Kigali, Rwanda on 8 August 2014, in collaboration with the Rwanda Environmental Management Authority (REMA). As a result, REMA is now publishing the maps on their website (see [http://www.rema.gov.rw/index.php?id=10&tx_ttnews\[tt_news\]=146&cHash=be89fb15be47d3e0c95d48c016c788c7](http://www.rema.gov.rw/index.php?id=10&tx_ttnews[tt_news]=146&cHash=be89fb15be47d3e0c95d48c016c788c7)).

- SERVIR-E&SA published all the LCLU datasets generated, and they are available for download at <http://servirportal.rcmrd.org> .
 - For the Map Service, visit <http://servir.rcmrd.org/ArcGIS/rest/services/landcover>.
 - The visualization tool is available at: <http://servir.rcmrd.org/geoapps/landcoverviewer/>. It can compare land covers from different years and schemes of classification.
 - Given internet connectivity issues in the region, DVDs were prepared and distributed during the national dissemination workshops to supplement the online services created. The DVDs contain all of the information generated under this project.
 - Ancillary data collection and development of land cover maps for Ethiopia, Mauritius, and Uganda have begun.
 - SERVIR-E&SA is supporting AST PI Scott Goetz and Co-I Nadine Laporte in developing a training workshop to estimate carbon as part of the AST project Forest Carbon Assessment for REDD in the SERVIR-E&SA Region. SERVIR-E&SA GHG team members will receive the training as well.
- The Forest Carbon Assessment for REDD+ in the SERVIR-E&SA Region project is helping East African countries participating in REDD+. Laporte and Goetz used NASA Earth observation satellite data to map biological corridors across the tropics. The results revealed that many such corridors are as rich or richer in vegetation and forests as the protected areas they connect. In providing such information to East African countries, this project has revealed that biological corridors are worthy of special focus in conservation efforts for many reasons. In addition, SERVIR E&SA is collaborating with this project to develop in-house capacity on REDD+ related topics. An example of this is the workshop (mentioned above) planned for November 2014 at RCMRD on the use of open source code to process satellite data to estimate carbon.

SERVIR-Mesoamerica

- SERVIR AST PI Allen Blackman of Resources For the Future is leading a project on Decision Tools for Targeting and Evaluating and Forest Conservation & REDD+ Policies in Mesoamerica. Two main objectives are to create a targeting tool and an evaluation tool kit. The targeting tool is designed to help guide where forest conservation policies should be sited. The evaluation tool kit will help assess the effectiveness of specific existing forest conservation policies in stemming deforestation. Both the tool and tool kit are designed to be web-based and interactive. This year, the team
 - Developed basic tool architecture using a desktop computer as a server, populating it with data for six REDD pilot sites in Mexico. This supported a USAID MREDD project and received praise from The Nature Conservancy (TNC), the technical implementing agency. For the rest of Mesoamerica, the team put together placeholder data on deforestation risk, biodiversity indicators, hydrological services, and carbon data. In August 2014, they visited potential end users in El Salvador, Costa Rica, and Panama, gaining feedback on a prototype system.
 - They assembled most of the requisite data for the evaluation tool kit, published a “how-to” manual, and identified potential case studies.

- Throughout the project they have kept abreast of ongoing REDD-related efforts in the region, particularly through the USAID-funded Regional Climate Change Program (RCCP), among others.

5.1.3 Disasters

This section describes SERVIR applications designed to support disaster preparedness, monitoring, and response.

SERVIR-Himalaya

- For the project called MODIS Ground Station Implementation and Regional Product Development, key FY 2014 activities are listed below.
 - SERVIR-Himalaya held a workshop 10-11 April to familiarize its national partners with MODIS products and services available via the MODIS receiver and acquisition system installed at ICIMOD/SERVIR-Himalaya in 2013. Datasets accessed via this receiver are automatically customized for end user's needs. Relevant professionals from Nepal, Pakistan, Bhutan, and Bangladesh attended and deliberated extensively on MODIS products and services for regional environmental applications and automated forest cover. Mapping information was gathered about the needs of these users and how MODIS datasets and value-added products can help meet those needs. Methods were discussed for disseminating the desired MODIS products to partners and member countries.
 - New MODIS level 2 products such as cloud cover and LST are being processed.
- For the project Multi-scale Disaster Risk Assessment and Decision Support System (DSS) for Disaster Risk Reduction (DRR), key FY 2014 activities are listed below. The ultimate goal is to develop an online DSS for DRR at national and sub-national levels.
 - There was a June 2014 training, organized by ICIMOD/SERVIR-Himalaya and the United Nations Office for Outer Space Affairs (UNOOSA), on using space-based resources for mapping disaster risks and guiding disaster response. The event increased national partners' understanding about use of a geospatial framework and remote sensing tools and techniques in disaster risk reduction. It also introduced disaster management professionals working in Bhutan, China, India, Myanmar, Nepal, and Pakistan to the tools needed for mainstreaming disaster risk reduction in development planning.
 - Historical data on disaster events has been compiled.
 - ICIMOD/SERVIR-Himalaya is supporting development of a disaster information management system (DIMS) as a component of a large national DRR platform in Nepal. The system provides information on potential hazards, vulnerabilities, and risks in each of Nepal's 75 districts to help support informed decision-making. The DIMS has been integrated with the DRR portal developed by MoHA.
 - Conceptualization of DSS for floods is nearing completion.
 - A drainage basin network database for a pilot site has been completed.
 - Data generation for the DSS is ongoing.
- The SERVIR AST JASON-2 Flood Early Warning System is proving itself in Bangladesh, where the Flood Forecasting and Warning Center (FFWC) has tested it this year, expanding from three stations to eight during the monsoon season. The system is slated for complete implementation next year. The system uses Jason-2 to track levels of the Ganges and Brahmaputra Rivers more than 600 miles upstream of Bangladesh and produces daily eight-day flood forecasts of water levels for several water stations. Key FY 2014 activities are listed below.

- NASA SERVIR AST member Faisal Hossain provided training 2-6 December 2013 in Kathmandu, Nepal to encourage use of satellite data for flood forecasting and managing water supply. Participants from Bangladesh, Bhutan, Pakistan, India, and Nepal participated in the event.
 - Since June 2014, FFWC has been successfully producing the eight-day Jason-2 based forecasts of water levels at major river locations of Bangladesh on a daily basis and making this information available on their website. The eight days advance notice is the longest lead time FFWC has ever been able to produce.
 - After the system performance evaluation is completed this monsoon season, FFWC hopes to launch a full scale Jason-2 based forecasting system for the public for 2015.
 - ICIMOD's Regional Database Initiative Lead traveled to the University of Washington for training in VIC modelling from Hossain. The intent is for SERVIR-Himalaya to develop the expertise to support FFWC as well as replicate the Flood Early Warning System in other regions.
- SERVIR continued operation/support in FY 2014 to the Nepal Forestry department for the SERVIR-developed Nepal forest fire detection and monitoring system. In addition, the system was extended to Bhutan and implemented together with Department of Forest and Park Services (DoFPS) under the Ministry of Agriculture and Forests (MoAF). The alert module through SMS was implemented in Bhutan mid-2014. The Minister of MoAF, the Director General of DoFPS, and District Forest Officials are now subscribed to the SMS alerts.

SERVIR-E&SA

SERVIR-E&SA is engaged in several activities to help the region leverage geospatial technologies for disaster risk reduction and enhance regional capacity in disaster management.

- Inception meetings and consultations were held in 2014 with national stakeholders in Rwanda to discuss development of a Web-based National Disaster Early Warning Information System in the country. This workshop helped tailor the project to end users' needs, increasing potential impact. (For example, the need for additional training in use and maintenance of the tool became apparent, so more training was built into the plan.) Data was gathered, and a plan was developed for portal implementation at the Ministry for Disaster Management in Rwanda. Key aspects of this activity are listed below.
 - A national web-based disaster information system is being created.
 - Products funded by WorldBank will be shared through this portal.
 - Infrastructure to create the portal is provided by Rwanda.
- SERVIR-E&SA is also partnering with the Department of Disaster Management Affairs in Malawi to develop hazard risk/vulnerability datasets and an atlas. A meeting was held with stakeholders in Malawi to discuss development of a hazard and disaster database for hazard risk identification and vulnerability mapping. Data gathering and database development and methodology planning are nearing completion.
- In addition, SERVIR-E&SA has been collaborating with the SERVIR AST in creating a Web-based Health Information System to support health risk management in Zambia. Inception meetings were held in July 2014 at the Ministry of Health in Zambia to ensure that this project is aligned with priorities on health risk management and to collect baseline datasets for the development of a health risk information system for the ministry. Activities for and implementation of the project were discussed, and a report was generated capturing data/information and

technical needs and providing recommendations and next steps. SERVIR AST member Pietro Ceccato trained SERVIR-E&SA personnel in vector-borne disease modeling and mapping with the goal of incorporating International Research Institute (IRI) Malaria risk data (rainfall and water bodies) in RCMRD and SERVIR web portals. Additional training is planned to build the technical capacity of ministry staff and other national stakeholders for carrying out context-based analysis of climate data and trends over Zambia or specific regions and how to relate that to health data and information collected by the ministry at community/facility level (data contained in the District Health Information Software, or DHIS).

- The other products developed in the AST project led by Ceccato included
 - Inundations derived from passive microwave on global scale at 25 km spatial resolution (<http://iridl.ldeo.columbia.edu/SOURCES/.NASA/.JPL/.wetlands/>)
 - Water bodies and turbidity derived from LANDSAT and MODIS region of interest is East Africa
 - Precipitation, temperature, vegetation, vectorial capacity model for Africa
 - Precipitation forecast (6 days) on global scale for International Federation of Red Cross and Red Crescent

The data are available via the IRI Data Library (<http://iri.columbia.edu>) in the maproom under health malaria

(<http://iridl.ldeo.columbia.edu/maproom/Health/Regional/Africa/Malaria/System.html>).

- Implementation, calibration, and validation of the CREST-based Flood Mapping Tool for producing inundation/flood extent maps began in the Nzoia and Thika Basins of Kenya, Manafwa Basin of Uganda, Sebeya Basin of Rwanda, and Okavango Basin of Namibia. Nzoia, Thika, and Manafwa Basin calibrations were completed. A working group involving the Kenya Department of Water Resources (KDWR), Water Resources Management Authority (WRMA), KMS, and universities was formed to select critical basins for Kenya. Development of web services and an email alert system is underway, as is training in use of this tool.
- RCMRD/SERVIR-E&SA now have direct access to real-time data from Earth observation satellites. Google.org funded a direct readout antenna for NASA's MODIS to help provide better situational awareness for disasters such as floods and wildfires and for other environmental issues. RCMRD/SERVIR-E&SA installed the MODIS receiving station on their premises in Nairobi, Kenya, and are helping to develop regional capability to operate the new tool and use the data it provides. The antenna receives data not only from MODIS but also from the Suomi National Polar-orbiting Partnership (NPP) mission, MetOp, Fengyun3, and NOAA18 and 19. The ground coverage is so huge that 75 per cent of Africa is covered by this receiving station alone. To the West, the antennae reaches to Nigeria (Atlantic Coast), to the East it reaches to Yemen, Seychelles and Mauritius (Indian Ocean), to the North up to Egypt and to the South to Johannesburg, South Africa. The cross-border data captured by MODIS can be shared to inform policies that help ordinary people cope with the impacts of a warming world.

SERVIR-Mesoamerica

- AST PI Dalia Kirschbaum from NASA GSFC leads a project called Landslide Hazard Assessment and Forecasting System using near real-time Remote Sensing Information over SERVIR-Mesoamerica. Accomplishments during FY 2014 include
 - Global rainfall-triggered landslide inventory (<http://ojo-streamer.herokuapp.com/>)

- Central America landslide monitoring and forecast system in beta (<http://ojo-streamer.herokuapp.com/meso>), based on data gathered from surveys sent to experts in Central America, combined with satellite and in situ data on landslide susceptibility
- System architecture built for open source release next FY

SERVIR CO

- SERVIR's Improving KMS Numerical Weather Prediction project brings NASA Earth observation satellite-derived datasets to bear on regional forecasting accuracy in Eastern and Southern Africa. This application strengthens KMS numerical weather prediction capabilities and increases the accuracy of weather forecasts in the region. In turn, improvements in weather forecasting are improving flood, drought, and frost forecasts. (This project is a collaboration with KMS in atmospheric modeling and verification with the WRF model.) SERVIR has established a working partnership with the NASA Short-term Prediction Research and Transition (SPoRT) Center for enhancing regional weather modeling capabilities over East Africa to support SERVIR's collaboration with KMS.
- Floods are a major challenge in the Okavango River delta. Namibia Hydrological Services (NHS) did not have an operational hydrologic modeling to warn the public of rising waters. The Hydrologic Model Calibration and Training in support of Namibia Hydrological Services Flood Forecasting Efforts project is underway to correct this situation. Key FY 2014 activities are listed below.
 - SERVIR supported NHS in calibrating data for Okavango River Basin flood modeling and mapping implementation of CREST.
 - In February, GSFC and SERVIR-E&SA held a Flood and Drought Risk Management workshop in Windhoek, Namibia. This training acquainted NHS with the model as well as how to calibrate it and validate it for local use.
 - SERVIR identified stream gauges for CREST model calibration in Namibia, consolidated the rainfall and streamflow data in a format accessible by CREST (NHS), and calibrated CREST for the identified stream gauges.
 - NHS has incorporated the CREST model products into their operations.
 - SERVIR is now supporting NHS scientists in additional calibration of stream gauges.
- Our ISERV camera system, operating since early 2013 onboard the ISS, has taken thousands of pictures of Earth and is being used to support disaster response, humanitarian relief efforts, adaptation to climate change, and environmental management. Both NASA and USAID have tasked ISERV to serve developing countries by providing observations of those countries from space. Some important FY 2014 ISERV activities are listed below.
 - As part of the international search effort for Malaysia Airlines Flight 370, ISERV acquired approximately 6500 images during April 2014. Many of these images were provided to the IDC and used for analysis by international agencies.
 - On 19 April 2014, SERVIR'S ISERV Team captured images of the burn scar from the Valparaiso, Chile wildfire that occurred 12 April 2014. They submitted the images to the IDC.
 - On 4 May 2014, the ISERV Team captured photos of the scar left by an EF-4 tornado in Louisville, Mississippi, 28 April 2014. The image above shows the region before (Landsat) and after (ISERV) the tornado. The National Weather Service Jackson, MS, office publicized the ISERV imagery via Twitter.

- SERVIR AST member Pietro Ceccato used ISERV to map ecosystems, urban areas, roads and water bodies that favor the reproduction of mosquitoes which transmit malaria and dengue in Zanzibar. His team is currently testing different classification methodologies to automatically map the ISERV data. In August 2014, he went to Zanzibar to validate the classification with field measurements. The final map will be provided to the President's Malaria Initiative and Malaria Control Program in Zanzibar to link with malaria cases in order to target control measures to eradicate malaria in Zanzibar.
- The new ISERV online viewer went live in June, streamlining access to ISERV imagery (<http://www.servirglobal.net/mapresources/iserv/>). Visitors can view and download a specific photo or multiple ISERV scenes from over 10,000 images. A new auto-georeferencing capability developed by the ISERV team allows for imagery to be posted online much more quickly. 60,000 ISERV images will be available over the next year for potential use in disaster and environmental assessments.
- The SERVIR CO also supported two summer interns who used NASA and commercial satellite images to pinpoint landslides in Rwanda and Uganda, in support of SERVIR-E&SA activities.

5.1.4 Air Quality

This section describes SERVIR FY 2014 activities related to air quality.

SERVIR-Himalaya

- A SERVIR-Himalaya sister project led by scientists at ICIMOD in collaboration with AST members aims to reduce transboundary air pollution in the HKH region. The approach is to develop high-resolution regional aerosol satellite products and explore the relationship between the satellite data and ground-based particulate matter measurements. Following an initial meeting with the ICIMOD air quality team and the Mountain Environment and Natural Resources Information System (MENRIS), AST PI Amy Thomas of the Battelle Memorial Institute participated in a workshop in June hosted by ICIMOD in the Pokhara region. During this event, information was collected on the needs and interests of end users and available ground data was also collected. A beta version of a visualization website (<http://servir-aq.dnsdynamic.net/himalaya.php>) has been created for the HKH region and shared with HKH stakeholders. ICIMOD plans to leverage its MODIS receiving antenna and existing geospatial platforms to facilitate the transition of AOD products to the ICIMOD geoportal to make them available to all end users.

SERVIR-Mesoamerica

- Thomas, along with Amy Huff of Pennsylvania State University, led a project called Satellite Applications for Air Quality Monitoring, Analysis, Forecasting, and Visualization. This FY, accomplishments included the following:
 - A beta version for a MODIS satellite visualization website for Mesoamerica was created, showing true color and aerosol optical depth (AOD) (<http://servir-aq.dnsdynamic.net/>). The provision of AOD at a 3km resolution represents a higher resolution than readily available through other sources. Stakeholder feedback will be gathered through a regional advisory group.
 - National air quality models in Costa Rica and El Salvador have made progress through the documentation of procedures and collection and formatting of model inputs.
 - An outreach and capacity building workshop on air quality communication was held in Panama.

SERVIR CO

- For the beta versions of air quality forecast models, the CO has worked with SPoRT so that they provide WRF outputs necessary to initialize the air quality model. By the end of the project, end users will provide their own WRF outputs to generate air quality forecasts.

5.1.5 Water Resources and Cryosphere

This section describes SERVIR applications designed to address water resources and cryosphere issues.

SERVIR-Himalaya

- For the Snow Water Equivalent project, an application has been developed that provides interactive snow cover mapping with major basin and sub-basin statistics. Snow cover maps have been generated using the MODIS eight-day snow product with additional improvements in information such as cloud cover. Eight-day composites of MODIS snow product (500 m resolution) were improved by removing cloud cover using combination and spatio-temporal filters. The data is available from the year 2002 to present. The snow cover data is presented for 92 sub-basins from the 10 major river basins of the HKH. Users can view basin/sub-basin statistics on snow cover for different elevation zones, slopes, and aspects. The snow cover maps can be displayed for a particular date or a specified time period using a time-slider tool.
 - Snow cover enhancement is being done for Bhutan. In fact, the Department of Hydro-Met Services in Bhutan, receiving automated snow cover maps, was among the first beneficiaries of the MODIS antenna installed at ICIMOD in 2013. Officials in Bhutan need timely, accurate snow cover mapping to manage the country's hydropower sector in terms of planning appropriate infrastructure. They access the MODIS data so they can have up-to-date snow cover mapping. Glacier melt is a major source of water in Bhutan, so information on snow cover mapping will be used to forecast river flow and subsequent hydropower generation. Availability of good snow cover data can aid hydropower operators in planning by ensuring that they run the plants optimally during snow melt and only do optional maintenance during forecasted low flows.
- AST PI Faisal Hossain of the University of Washington leads a project called Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan Region. In addition to the flood forecasting progress described in the Disasters section (5.1.3), there are hydrologic and hydraulic modeling components focusing on the Ganges, Brahmaputra, Meghna, and Indus basins.
 - Hydrologic model VIC-3L was set up for all four basins to simulate daily fluxes. Integration into the ICIMOD geoportal has begun and will ultimately enable users to access historic, daily (nowcasts), and seasonal forecasts (30-180 days) through a web-GIS interface.
 - Seasonal forecasts are undergoing rigorous assessments, thanks to climate model outputs from AST members Pete Robertson and Jason Roberts.
 - The Hydrologic Engineering Centers River Analysis System (HEC-RAS) model is set up for Ganges, Brahmaputra, and Meghna basins, allowing for improved forecast skill and potentially longer forecast time. An extensive manual was created to allow any stakeholder agency to set up / customize / upscale / downscale their own hydraulic models.
 - A workshop was held for end users and stakeholders from 10 agencies; it focused on hydrology and hydraulic modeling, gravimetry data, satellite-based rainfall data, and understanding related challenges that stakeholders in HKH face.

- AST PI Jeff Kargel from the University of Arizona leads a cryosphere-related project on Glacier and Alpine Hazards to Development and Habitation in the Hindu Kush-Himalaya Region. FY 2014 activities included
 - Field investigations on the Seti River outburst flood
 - Thulagi Lake hazards and vulnerability studies, including lake bathymetry, glacial lake outburst flood mechanisms and models, and downstream vulnerabilities
 - Classification of moraine dams and movement of glaciers using ASTER imagery
 - Town hall meetings and training workshops in conjunction with ICIMOD and universities
 - ICIMOD has contributed to the Global Land Ice Measurements from Space (GLIMS), a global resource on glaciers

SERVIR-E&SA

- For the CREST Model Expansion to Uganda, Rwanda, and Namibia project, CREST training workshops were held in all three countries. The CREST model is already running in two river basins in Kenya (Nzoia and Thika) and in Uganda's Manafwa basin. Calibration is being performed for the Sebeya basin in Rwanda and Okavango basin in Namibia. A near real-time alert system via automated emails to water authorities will be implemented in Kenya.
- For the Lake Victoria Water Quality and Ecosystem Management project, data collection and processing as well as map development and analysis for water quality and ecosystem degradation/erosion are nearing completion. This project uses MODIS data to reveal historical and current water quality conditions for the lake as well as surrounding area erosion and degradation. It is targeted for Kenya and for the five countries surrounding the lake. It enhances capacity to monitor and manage Lake Victoria water resources. Water quality maps and parameters have been produced and algorithms have been developed for a water quality model. RCMRD will run this model when it is completed, and they will calibrate and validate it.
- AST PI Juan Valdes and Co-I Aleix Serrat-Capdevila from the University of Arizona area are leading the SERVIR Water Africa – Arizona Team (SWAAT) project in SERVIR-E&SA. Objectives include developing near real time monitoring and forecasting applications to support water resources management and to quantify future impacts of climate variability and change on water resources to inform current and future adaptation strategies. FY 2014 achievements include
 - Three streamflow simulations, including VIC, HyMod, and HBV (Hydrologiska Byråns Vattenbalansavdelning) models, are now running in real time, pulling data from Tropical Rainfall Measuring Mission (TRMM), CMORPH, PERSIANN, and CHIRPS rainfall products. These currently cover the Mara basin and Upper Zambezi basins.
 - Calibration/validation efforts have shown that a SWAT (soil and water assessment tool) model has mimicked fairly the seasonality of observed flow of the Nyangores River in Bomet. Validation of the other models is ongoing.
 - RCMRD has played a strong role in connecting the AST researchers to management agencies in Kenya, organizing workshops, and facilitating ground validation data. In June and July of 2014, RCMRD hosted a workshop that brought together stakeholders and researchers to discuss hydrologic forecasting efforts, dealing with uncertainty, characterizing decisions made in the water management cycle, the implications for tools and forecast design, and synergies with other projects.

- AST PI James Verdin of USGS leads the project, Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa. Main outputs include a ~30 year time series of daily rainfall grids at 0.05 degree resolution for Africa and a water requirement satisfaction index (WRSI) as a long time-series indicator of agricultural drought. Synergies through the USAID PREPARED program for climate change adaptation include working with the Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) on gridding climate data and analyses, with RCMRD on access to geospatial climate data and tools as well as vulnerability impact analysis mapping, and with USAID OFDA (Office of U.S. Foreign Disaster Assistance) on a GIS Flood Tool. FY 2014 accomplishments include
 - Completion of an initial 30-year CHIRPS gridded rainfall time series for Africa (<http://chg.geog.ucsb.edu/data/chirps/index.html>)
 - A CHIRPS rainfall data web interface activated at the University of California Santa Barbara using the Early Warning eXplorer (EWX) (<http://chg.geog.ucsb.edu/tools/ewx/index.html>)
 - GeoCLIM (<http://chg.geog.ucsb.edu/tools/geoclim/index.html>) and GeoWRSI (<http://chg.geog.ucsb.edu/tools/geowrsi/index.html>) software for CHIRPS applications introduced, particularly at a workshop held with ICPAC that brought participants from the East Africa Community, Kenya, Uganda, Tanzania, Burundi, and Rwanda.
 - The data from this effort is being used by the CHIRPS and NDVI analysis tool for the USAID Senegal effort (section 5.1.1).

5.1.6 AST Projects

AST collaborations with hub projects were discussed above in their respective thematic areas. In addition to those collaborations, AST member Pete Robertson is developing climate scenarios tailored to the unique geographic and thematic needs and requirements of many AST projects. Of particular emphasis are seasonal forecasts and multidecadal simulations for SERVIR regions. FY 2014 accomplishments related to Robertson's scenarios include the following activities:

- Enhanced seasonal precipitation outlooks were obtained by incorporating large-scale SST and precipitation simulations in the US National Multi-Model Ensemble (NMME). CHIRPS data were among the inputs included.
- Statistical significance skills for seasonal amounts and frequency of rainfall were calculated for observed and predicted datasets. Overall, higher skill was achieved during October-December than March-May seasons. These skill scores will come to bear in upcoming AST project applications.
- Integration with the USAID PREPARED climate adaptation program was coordinated through Chris Funk (Co-Investigator on Robertson's SERVIR AST project and on Jim Verdin's SERVIR AST project, Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa), particularly through travel to Arusha, Tanzania, and Nairobi, Kenya. He worked closely with East African Community scientists in their productions of 1981-2013 grids of monthly precipitation, allowing them to analyze climatological risk and examine precipitation trends.

Table 2 lists all of the SERVIR AST PIs, projects, themes, and regions.

Table 2. AST PIs, Projects, Themes, Regions

PI	Project	Theme(s)	Region(s)
Allen Blackman	Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic	Ecosystems and sustainable landscapes	Mesoamerica
Pietro Ceccato	Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring and Climate Information for Disaster Management and Human Health (integration within SERVIR)	Disasters	E&SA
Stephanie Granger	East Africa Drought and Agricultural Productivity Assessment and Prediction System	Agriculture and food security	E&SA
Faisal Hossain	A Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan region	Disasters; Water resources and Cryosphere	HKH
Jeff Kargel	Glacier and alpine hazards to development and habitation in the Hindu Kush-Himalayan region	Disasters; Water resources and Cryosphere	HKH
Dalia Kirschbaum	Landslide Hazard Assessment and Forecasting System using near real-time Remote Sensing Information over SERVIR-Mesoamerica	Disasters	Mesoamerica, HKH
Scott Goetz, Nadine Laporte	Forest carbon assessment for REDD in the East Africa SERVIR region	Ecosystems and sustainable landscapes	E&SA
Pete Robertson	Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for Climate Prediction	(Cross-cutting)	All
Amy Thomas	Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR-Mesoamerica and Himalaya Regions	Air quality	Mesoamerica, HKH
Juan Valdes	SERVIR Water Africa-Arizona Team (SWAAT)	Water resources and Cryosphere	E&SA
Jim Verdin	A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa	Water resources and Cryosphere; Agriculture and food security	E&SA

5.2 Training and Capacity Building

FY 2014 science application-specific training was covered in section 5.1. This section focuses on other SERVIR training and capacity building activities.

5.2.1 Crowd-sourcing

SERVIR-Himalaya

- SERVIR-Himalaya completed a project outlining the technical design and overview of a USAID/ICIMOD Semantic Crowd-sourcing application for Ecological Monitoring and Knowledge Management. The project is designed to provide an end-to-end integrated platform for scientists, volunteers, and taxonomists at ICIMOD to analyze the ecological information in the Himalayan region. The platform can be used as a
 - Crowd-sourcing application that enables mobile data capture and transmission to submit ecological data from the fields

- Browser-based interface for taxonomists to add ecological data to the geo-tagged information from the fields
- Browser-based semantic platform to browse and visualize the available knowledge

In addition to the technical design and overview of the application, the project identified future steps to improve the prototype and take it closer to a pilot release.

5.2.2 GIT Training and Capacity Building

SERVIR CO

- At the SERVIR CO GIT Boot Camp 24-28 March 2014, GIT teams from across the hubs and the CO gathered to share experiences on data management and implementation of geospatial technologies, and discuss the latest advances in GIS servers and the benefits of using flexible and highly scalable cloud infrastructure to deliver products and services. This event also marked the beginning of a GIT Community of Practice, through which the project expects to increase collaboration between hubs and facilitate the integration of GIT systems in the SERVIR Global website, product catalog, and visualization systems. Continuing with these efforts, GIT experts have collaboratively developed applications to visualize valuable information such as hydrological data and LCLU maps.

5.2.3 Stakeholder Engagement Projects

SERVIR CO

- The NASA/SERVIR Stakeholder Engagement Project: Index Insurance, with IRI, fostered interaction between the index insurance, agriculture, climate and meteorological, development/climate risk management, and economics communities and SERVIR in order to
 - Address the active demand for remote sensing knowledge in index insurance projects in which IRI is connected
 - Engage and further develop existing partnerships
 - Develop and execute a process through which needs and capabilities are identified
 - Integrate SERVIR/IRI activities into ongoing index insurance implementation processes

The stakeholders in this work included UN Agencies, private sector insurance and agricultural companies, producers of climate information, and national government agencies. The project used these partnerships and continued to cultivate new ones, linking SERVIR to index insurance and remote sensing processes in East Africa. Through this project, there were three primary stakeholder engagement and capacity building workshops on remote sensing and index insurance held in FY 2013 that have allowed stakeholders to link the SERVIR process and RCMRD (SERVIR-E&SA Regional Hub) to partners who are developing knowledge and demand for remote sensing information.
- Under the NASA/SERVIR Stakeholder Engagement Project: Health, with IRI, there was a Training Workshop and Stakeholder Meeting hosted by the Tanzania Meteorological Agency (TMA) in collaboration with the World Meteorological Organization (WMO), the Health and Climate Foundation (HCF), NASA, and IRI in October 2013. Recent activities led by TMA and IRI combined available ground observations of rainfall and temperature with satellite and other proxies, pioneering new open-access products and creating one of the highest resolution and longest data records for Africa. In particular, outcomes of this work included
 - An unprecedented thirty-year time series of ten-daily rainfall and temperature data for every 10 km grid across the country
 - An online mapping service installed at TMA providing user-friendly tools for visualization, querying, and accessing information
 - Increased technical capacity at TMA

The primary objectives of the workshop in Tanzania were to showcase TMA's recently launched high resolution products, demonstrate examples of how they can be used in combination with NASA products for disease stratification, improved early warning systems, and impact assessments, as well as to solicit critical feedback from the health community on their needs for climate, environmental, and epidemiological information, in particular for use in malaria decision-making. The workshop provided a unique opportunity to engage the Tanzanian climate and health communities, in particular collaboratively advancing current risk maps of malaria, integrating climate and environmental factors into ongoing stratification efforts, providing improved information and tools for critical early warning systems and impact evaluations of interventions towards malaria control and elimination. In addition, the overall recommendations from this workshop provided a significant contribution to better understanding practitioner and stakeholder needs for the use of climate and environmental information in improved health decision-making.

5.2.4 Youth Programs

SERVIR-Himalaya and CO

- The NASA International Space Apps Challenge is an international mass collaboration engaging developers, GIS-savvy students, engineering students, and entrepreneurs to collaborate on solving challenges relevant to improving life on Earth and in space. The Space Apps Challenge in Kathmandu, Nepal, 12-13 April 2014, drew more than 60 participants. They divided into 16 teams and used publicly available Earth observation resources and geographic information and communication tools to devise creative ways of tackling global challenges related to Technology in Space, Human Space Flight, Asteroids, Earth Watch, and Robotics. SERVIR submitted two challenges:
 - SERVIR CO's Jagan Ranganathan developed the Earth Images from Space Station Challenge (description of this challenge is posted under "Earth Watch" at <https://2014.spaceappschallenge.org/challenge/earth-images-space-station/#description>).
 - SERVIR AST member Dalia Kirschbaum developed the Track a Landslide Challenge (description of this challenge is posted under "Earth Watch" at <https://2014.spaceappschallenge.org/challenge/track-landslide/>).

At an orientation meeting for the event, SERVIR Project Direct Dan Irwin gave a motivational speech to the participants. Irwin shared his experience on the value of the Space Apps Challenge results to NASA and society in general. He also kicked off the event on 12 April 2014.

- ICIMOD/SERVIR-Himalaya hosted youth forums in Bangladesh, Bhutan, and Nepal in late 2013 and early 2014, bringing together students from several higher learning institutions in the countries. The youth enjoyed presentations about environmental impacts of climate change, and they were taught how to use Earth observation information and geospatial tools to better understand those impacts.

CO

- Since its inception, the highly successful global environmental fellowship program called My Community Our Earth (MyCOE) / SERVIR has harnessed the imaginations and energy of many young innovators. MyCOE / SERVIR program Fellows are competitively selected from among hundreds of applicants proposing research in areas related to the theme of a particular 10-month MyCOE / SERVIR Fellowship term. Themes have included Climate Change, Agriculture, and Food Security in East Africa; Climate Change in Mountain Area Regions in the Himalayas; Three Generations of Women in Climate Change and Food Security in West Africa; and Climate Change, Landscape and Watersheds in Southeast Asia. Following an initial round in 2009-2010

for participants in countries served by the SERVIR-E&SA hub, the MyCOE / SERVIR Initiatives continued in 2012-2014 in both hub regions as well as the lower Mekong region, wrapping up with the MyCOE / SERVIR Capstone Event on 3-4 April 2014 in Washington, DC. USAID and NASA joined hands to host this special gathering sponsoring fourteen of the best and brightest young innovators from across the globe engaged in geospatial technology-based environmental research. These Fellows were chosen to describe their projects and share their hopes and plans as stewards of the Earth with USAID and NASA scientists and personnel, including USAID Administrator Rajiv Shah and NASA Administrator Charles Bolden, in the nation's capital.

- SERVIR is sponsoring MyCOE Capstone Fellow Susan Malaso of SERVIR-E&SA as a graduate assistant as she pursues her Master's degree in Earth Systems Science at UA-Huntsville.

5.2.5 National Geospatial Portals and Committees

SERVIR-Himalaya

SERVIR-Himalaya has been working to provide geospatial information services in Bhutan and Nepal by developing national geospatial portals to improve the capacities of the two countries and coordination among different agencies in leveraging geospatial information services at the national level. The national geospatial portals will be one-stop shopping for SERVIR and other related initiatives to leverage existing geospatial data, services, applications, and infrastructure. The following activities took place:

- The baseline in each country was assessed.
- A national consultation workshop was held in March 2014 in Thimphu, Bhutan, to assess requirements of and level of user support for a national geospatial portal for Bhutan. Another aim of the workshop was to build collaborations for this effort.
- ICIMOD designed and developed technical specifications and undertook the development of a national geospatial portal with open access to data and information services. The technical specifications were taken into account of providing integrated geo-data and information services across multiple themes and scales.
- The Bhutan National Geospatial Portal was launched on 13 October 2014 by the Queen of Bhutan.

Work continues into FY 2015 on the development and testing of the prototype for the Nepal national geospatial portal.

SERVIR-E&SA

Within RCMRD's 20 member States in Eastern, Central, and Southern African Regions, there are many agencies that use geoinformation resources and services. For efficient provision of services to enhance data sharing and usage to support decision-making, RCMRD/SERVIR E&SA is assisting member states in establishing National Geospatial Information Committees (NGICs) to guide development of national geospatial portals. The following countries are targeted for NGIC development and implementation: Malawi, Rwanda, Swaziland, Ethiopia, South Sudan, Seychelles/Mauritius, and Tanzania. In 2014 the following activities took place:

- On 28th February 2014, a service agreement was entered into between the Ethiopian Mapping Agency and RCMRD regarding the development and establishment of a GIS web geoportal. The geoportal's purpose is to serve as an online platform for publishing and sharing various GIS datasets the Ethiopia Mapping Agency has prepared. The key functionalities of the portal are (1) to browse, search, download GIS datasets, and upload documents; (2) to upload GIS datasets and access shared maps; and (3) to visualize GIS datasets using an Interactive Web Map Explorer. The project was kicked off with a hardware,

- software, and network assessment in March. The GIS web geoportal was successfully deployed and configured between 24 July 2014 and 20 August 2014. There were 14 staff members trained, including IT personnel and end users. The training targeted the end users, mainly GIS and remote sensing staff, who would be doing the actual uploading of the portal and entering the metadata. The IT staff trained were those who will offer backend support and management of the portal as well as handle trouble-shooting.
- In February 2014, RCMRD facilitated the meeting of the Technical Working Group (TWG) of the Rwanda NGIC and a high level policy meeting with government officials. In addition, RCMRD conducted a technical training workshop to improve participants' geo-information skills and also foster sharing and distribution of geospatial information within Rwanda's governmental agencies, nongovernmental organizations, and other institutions. The technical training content included an introduction and review of data sharing policy documents, metadata concepts, metadata development, SDI Clearing House/catalogue (hands-on training), and an overview of Geonode. The training was attended by a total of 31 participants from 13 different agencies.
 - In May 2014, RCMRD/SERVIR-E&SA, in cooperation with the Mauritius Ministry of Housing and Lands, facilitated a high-level policy meeting attended by 61 representatives from 18 governmental and non-governmental organizations and institutions, and conducted a technical training for 36 participants from various government agencies and other stakeholder institutions. The main contents of the technical training included an introduction and definition of National Spatial Data Infrastructures (NSDI) concepts, basic metadata concepts, metadata creation, fundamental techniques of publishing, sharing, and distributing metadata online using various tools, visualizing GIS data, and data conversion from AutoCAD to GIS formats.
 - At the request of the Rwanda National Resources Authority, SERVIR availed two technical trainers from RCMRD to conduct hands-on training on metadata creation in August 2014.

5.2.6 Small-scale Applications

SERVIR-E&SA

The SERVIR-E&SA Small-Scale Applications (SSAs) are intended to help grow the network of organizations, universities, and institutions within the SERVIR-Eastern and Southern Africa region that use geospatial data, tools, and services to improve decision-making related to climate adaptation, vulnerability, or mitigation. The purpose is to build capacity in the region and improve the use and impact of SERVIR tools, products, and services toward empowering governmental and government-affiliated institutions to make better-informed decisions.

RCMRD issued a Call for Concept Notes, designated APS 201, with thematic areas including Agriculture Risk Management, Water Resources Management, Ecosystems and Sustainable Landscapes, and Disasters, along with a GIT component. The RCMRD member states of Botswana, Burundi, Comoros, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Namibia, Rwanda, Seychelles, South Africa, Swaziland, Tanzania, Uganda, and Zambia were eligible to apply. Concept Notes received CO feedback and RCMRD SSA Team rankings, and went before an RCMRD Steering Committee, out of which process seven Concept Notes were selected to receive the RFP. Six of these applicants responded with full proposals, and again went through RCMRD's review and selection process, from which the Steering Committee selected three proposals. In addition to these three, RCMRD identified two activities through a separate process for direct funding, for a total of five projects under the SERVIR-Eastern and Southern Africa SSA activity. Completion of all projects is planned for on or before 31 July 2015. Each of the selected proposals is listed below with project titles and institution names.

- Implementing the first stage of an Indian Ocean Global Warming Observatory based in Seychelles—Nature Seychelles
- Integrated Flood Modeling for Flood Hazard Assessment in Kigali City, Rwanda—University of Rwanda
- Operational Monitoring of Water Quality on Lake Victoria Using Satellite Imagery—Makerere University, Department of Geomatics and Land Management
- Web-based GIS Water Resource Management System for the County Government of Wajir — County Government of Wajir, Kenya
- Enhancing Weather Forecast Modeling Capabilities in Support of SERVIR Activities with the Kenya Meteorological Services — KMS

SERVIR-Himalaya

The SERVIR-Himalaya Small-Scale Applications are intended to help grow the network of organizations and institutions within the region that use geospatial tools and services. The purpose is to allow for innovation, improve data capturing and dissemination, and enable decision-makers and key stakeholders within the HKH region to better integrate Earth observation information and geospatial technologies into development decision-making and to take complete advantage of SERVIR resources in the region.

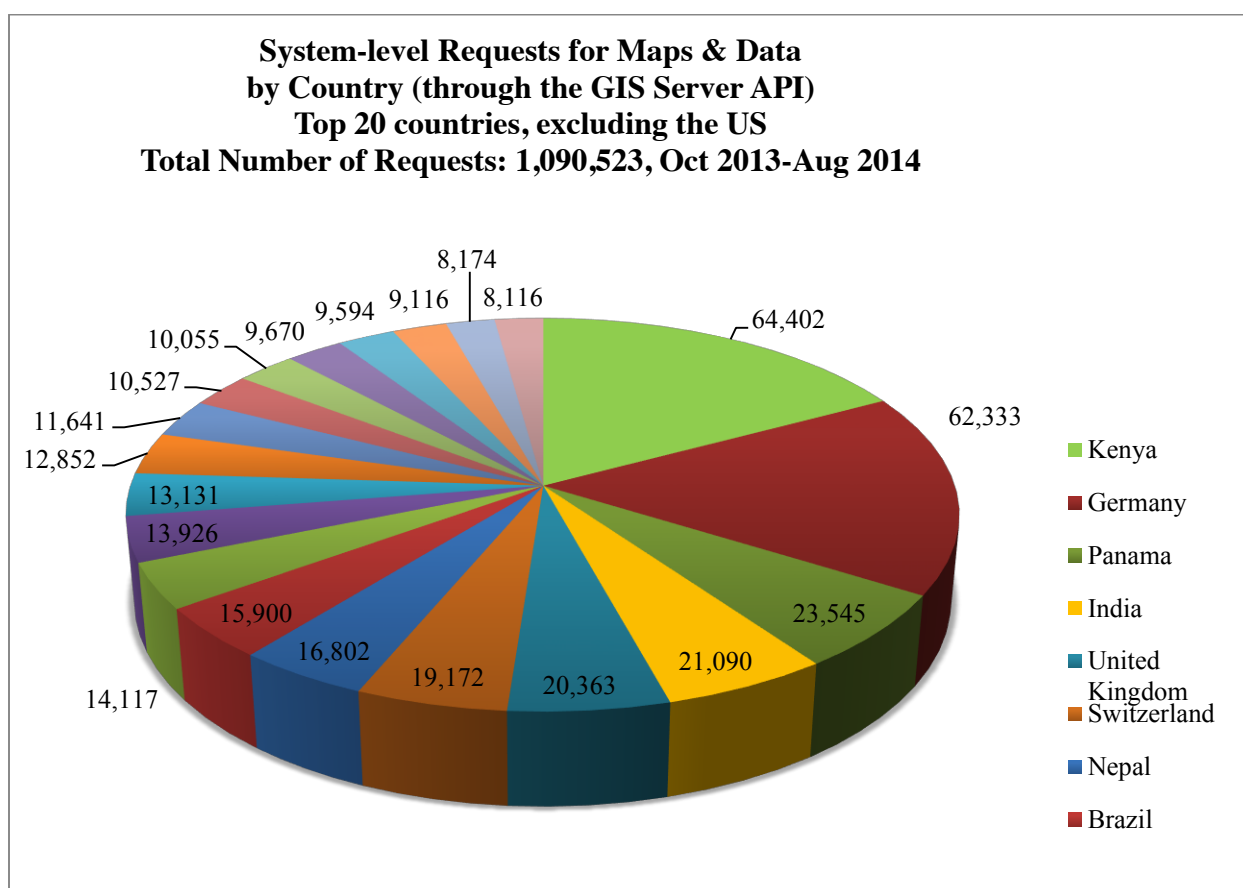
Following a process that included identification of thematic application areas of interests and potential innovative applications, ICIMOD sent out a limited call addressing several topic concepts. This resulted in three proposals selected. In addition, two direct-funded applications were selected, and a proposal was received as a result of a ‘partner-demanded’ activity for direct funding. Each of the selected proposals is listed below with project titles and institution names.

- Interactive web and mobile app using open-source data and open-source software for creating disaster and emergency response system—Kathmandu University
- Estimation of above ground forest biomass and carbon stock using UAV images—Kathmandu University
- Engaging Local Citizens to Collect and Map Agriculture, Environment, and Food Security Data—Kathmandu Living Lab
- Implementation of JASON-2 Satellite Altimetry-Based Flood Forecasting System at Flood Forecasting and Warning Center (FFWC) of Bangladesh Government—Institute of Water Modeling
- Integration of GIS, remote sensing, and field observations for assessing grazing intensity and rangeland health to support decision-making for rangeland management in Gilgit-Baltistan—Mountain Agricultural Research Centre, Gilgit / Karakoram International University, Gilgit (MARC/KIU)
- Community Based Forest-fire Information System (CBFiIS) for forest managers—Nepal Foresters' Association

5.3 Core Infrastructure and Regional System Implementation

SERVIR CO

- The SERVIR Global platform has continued to evolve, migrating the current set of web map services to a more robust technological stack and more efficient data structures, resulting in significant performance and scalability improvements. The usage statistics compiled up to August 2014 (11 months of data) already show an increase in reference to the previous year (October 2012-September 2013), before adding the usage corresponding to September. The map services published from the global components of the platform can be accessed at <http://gis1.servirglobal.net/>. The regional hubs have their independent mechanisms to serve maps, which include a mix of SERVIR-produced datasets as well as others developed in collaboration with their partners.



- The regional hubs have also acquired new hardware and software to improve their ability to process, store, and publish data, and are currently configuring and implementing these assets. In addition to this new physical infrastructure, both hubs are in the process of setting up servers using cloud infrastructure, exploring the benefits of this flexible architecture to adapt to changing usage patterns.
- SERVIR is also preparing to re-launch the SERVIRGlobal.net website, after careful reconsideration of audiences, content, and messages. The new version of the SERVIRGlobal.net website will present users a fresh and modern interface providing easier access to a rich collection of resources (data and applications, multimedia materials, information about project activities, etc.).

- In terms of facilitating access to relevant datasets, SERVIR has created user-friendly web applications, suitable for mobile devices to visualize and download ISERV images, access hydrological time-series data (CREST), and visualize changes in MODIS-derived land cover at different points in time. These applications are primarily offered as patterns or templates for development of custom interfaces. In effect, hub staff have adapted and/or extended them to be used in specialized scenarios or with particular datasets, like the Land Use/Land Cover data derived from the GHG project executed by RCMRD/SERVIR-E&SA.
- Search effectiveness for the SERVIR Data Catalog has been improved. In collaboration with the hubs, the CO has initiated an inventory of SERVIR-developed datasets and is working along with the hubs to improve metadata records to facilitate discoverability of these datasets through standards-based catalog system queries. To complement this effort, custom pages have been built for the SERVIRGlobal.net webpage and the GIT team has been working with DAI and USAID to design a new map visualization to replace the Interactive Mapper in SERVIRGlobal.net.
- The CO also provided assistance to the regional hubs for acquisitions of Geospatial IT infrastructure. The CO helped review and refine the technical specifications for hardware and software acquired by the hubs to supplement their existing infrastructure according to the plans prepared in 2013. During 2014 the hubs acquired and installed new servers and workstations to augment their existing capacity to collect, process, distribute, and store Earth Observation data.
- Progress has been made toward migration of the SERVIR Global servers. Following NASA's IT security guidelines and procedures, the CO has transferred the server functions previously hosted by SSAI during the early stages of design and implementation of the project's infrastructure to a high-performance, secure infrastructure managed by NASA WESTPrime contractors. The servers are scheduled to start operating in production mode in October 2014. Extensive testing has been performed to guarantee that no disruptions are experienced once the new servers go live.

5.4 Communications and Outreach

SERVIR's CO communications lead activities included the following during FY 2014:

- Technical input and review of SERVIR product catalog content.
- Wrote 70 articles, including success stories, for the SERVIRGlobal.net website.
- Supported hub communication leads as needed.
- Created SERVIR Hyperwall Presentation.
- Created documents for SERVIR reporting to NASA headquarters, NASA Marshall, and USAID leadership. (Examples include the SERVIR annual reports, work plans, the SERVIR section of the NASA Applied Sciences Capacity Building Program Annual Summary, Applied Sciences Program Reviews, Monthly Status Reviews, Manager's Program Reviews, weekly notes, etc.)
- Supported SERVIR team as needed on other communications tasks.
- Ensured consistency, grammatical correctness, and clarity of SERVIR communications materials.
- Participated in website redesign.
- Provided social media support such as providing materials for posting to SERVIR Facebook page.
- Provided input and content for/review of DAI's and DAI subcontractors' SERVIR communication products.
- Supported DAI development of global communication strategy.

5.5 Project Management and Project Support

5.5.1 Project Management

During the past year, CO and Demand Team representatives collaborated and enhanced a joint planning process by which both teams' deliverables and requirements were jointly managed and statused. This was part of an overall integrated demand and supply process that NASA, USAID, the Demand Team, and affiliated hubs performed together.

During this reporting period, the hubs took direct ownership of their respective schedules and submitted status on a routine basis in regard to the work plan tasks that are tracked via an Integrated Master Schedule (IMS). The SERVIR PMP (version 2.0, released spring of 2014) provided general direction on overall management of SERVIR indicators and deliverables, scheduling, performance management, and reporting. The PMP is prepared annually to address the new work scope, deliverables, and indicator assignments to ensure synchronization with the work plan.

The 2014 Work Plan was prepared and coordinated, covering about 61 deliverables identified from the hubs as well as the CO. These deliverables formed the backbone for this year's PMP. The PMP was organized around the approved work plan tasks as well as intermediate results (IR) of the SERVIR Results Framework. The CO and Demand Team collaborated and drafted a SERVIR strategic plan, which is under review as of this writing.

This year, weekly meetings were held routinely among NASA HQ, USAID HQ, the Demand Team, and the CO to enable better communication among the key decision-makers. In addition, monthly reviews were held with the hubs to enable discussions of task progress and any concerns or issues.

Control Plans and Processes

The SERVIR Project uses existing NASA and USAID policies and procedures, as appropriate, to perform administrative, operational, or programmatic specific tasks and functions. However, in cases where, due to SERVIR's unique mission, existing processes do not conform to the reality of the work, a Standard Operating Procedure (SOP) was prepared to address the unique steps required. An analysis of all tasks was performed by the CO, and an initial determination was made that most of the functions are addressed by existing NASA / USAID directives. It was determined that eight processes required SOPs. These processes were related to travel, IT security, risk management, reporting, documentation management, and website guidelines. The first annual JWG was held among NASA and USAID officials in February of 2014, providing a venue for review of accomplishments and goals from an agency-level perspective to help provide guidance to the project.

5.5.2 Project Support

Over the course of the year, the SERVIR team supported or held a number of key exchanges, meetings, and reviews, listed below.

- The SERVIR AST Quarterly Review was held 31 October 2013. Status was given for the grants to universities and other NASA Centers, with participants from the CO, The Demand Team and NASA Headquarter personnel. Discussions of AST members' participation in upcoming annual review, potential scientific interests in the future SE Asia hub, and participation in the December AGU SERVIR Town Hall were discussed.
- John Grunsfeld, NASA Associate Administrator of the Science Mission Directorate, visited ICIMOD in Kathmandu, Nepal and the USAID mission Regional Mission for Southeast Asia (RDMA) in Bangkok, Thailand during the week of 7 November 2013.

- Dan Irwin made a trip to Nepal and Bhutan with NASA Applied Sciences Capacity Building Program manager Nancy Searby the week of 25 November 2013. Their activities included attending the ICIMOD Board of Governors meeting in Nepal and the Bhutan GIS Conference.
- SERVIR AST first annual meeting was held in San Francisco, CA, 8 December 2013, to discuss project progress, next steps, and collaborative efforts, and to take the next steps in Tiger Team efforts to address end user needs in SERVIR hub regions.
- SERVIR's Dan Irwin, Tia Ferguson, Cereese Albers, and several SERVIR AST members, as well as Nancy Searby, attended AGU the week of 9 December 2013 and hosted the first AGU SERVIR Town Hall Meeting on 11 December. SERVIR AST members gave innovative 2-minute, 1-slide overviews of their work with SERVIR and engaged the AGU community by exploring examples of connecting Space to Village with SERVIR science applications.
- Joint USAID/NASA/SERVIR hub meetings were held for work plan discussions at the SERVIR-E&SA and SERVIR-Himalaya hubs 2-10 December and 11-18 December, respectively. SERVIR's Gwen Artis and USAID's Jenny Frankel-Reed and Albert Anoubon-Momo traveled to the SERVIR hubs for joint work plan meetings to help finalize task prioritization for the hubs' 2014 work plans, making it possible to have the hubs' contracts in place by mid-January 2014.
- Dan Irwin, Ashutosh Limaye, and Eric Anderson traveled to Nepal 7-11 April 2014 for meetings at SERVIR-Himalaya regarding integration of the SERVIR AST air quality project led by Amy Thomas of Battelle with ICIMOD's other air quality efforts. Jointly, the ICIMOD air quality modeling group and Thomas have outlined several activities to accomplish common objectives of linking air quality observations and modeling products to benefit end users in the region. The CO team also participated in a MODIS product awareness and end user feedback workshop and met with the Nepal MoAD to discuss ongoing SERVIR-Himalaya/MoAD efforts to compile a digital agriculture atlas and drought assessment for food security analysis for Nepal. USAID-Nepal colleagues were excited to hear about the SERVIR-Himalaya/MoAD collaboration and planned to write a "success story" about it.
- Dan Irwin, Tia Ferguson, and Ashutosh Limaye, traveled to Washington, DC 21-23 April 2014 for meetings at NASA HQ regarding strategic planning for the SERVIR Project. Lawrence Friedl (NASA Applied Sciences Program Director) and Bill Breed (USAID Chief of Global Climate Change Office Analysis, Innovation and Demonstration Division) participated. Topics included revision of mission and vision, evaluation of SWOT analysis, theory of change, expansion, partnering, and how to better influence decision-making.
- SERVIR's Africa Flores attended the NASA Biodiversity and Ecological Forecasting Team Meeting 7-9 May 2014 in Washington DC. The NASA Biodiversity and Ecological Forecasting Team includes PIs and their designees funded by the NASA Biodiversity Program (a NASA Earth Science Research and Analysis Program) or the NASA Ecological Forecasting Program Element (a NASA Earth Science Applied Sciences Program). NASA also invites students with relevant projects in the NASA Earth and Space Science Fellowship (NESSF) Program and their advisors to become part of the team, as well as those addressing relevant topics in the NASA New Investigator Program and other Earth Science programs.
- 21 May - 1 June 2014, SERVIR team members Gwen Artis and Africa Flores traveled to Mauritius to help prepare for and participate in the NGIC high-level stakeholder meeting and technical training to be conducted by SERVIR-E&SA team members from RCMRD. In addition, since travel to Kenya was severely restricted, they participated in additional meetings with RCMRD management, the SERVIR-E&SA technical team leads, and members of the SERVIR Demand Team to accomplish previous meeting objectives that remained outstanding due to earlier travel restrictions.

- SERVIR CO team members (Dan Irwin, Tia Ferguson, Ashutosh Limaye, Gwen Artis, Dauna Coulter) / SERVIR Demand Team participated in a joint meeting 9-10 June 2014 in Washington DC with USAID and NASA SERVIR leadership and Demand Team representatives to discuss gaps and potential synergies in SERVIR supply and demand. Results from the meetings helped streamline SERVIR planning and operations.
- ISERV PI Burgess Howell and ISERV Ground Operations Lead Jagan Ranganathan attended the ISS Research & Development Conference 17 -19 June 2014, in Chicago, Illinois, and made several connections, including discussions with ISS Program Manager Michael Suffredini concerning current payload operational constraints, and with Associate ISS Program Scientist for Earth observations Will Stefanov about future ISERV operations and science output.
- On 10 June 2014, RCMRD/SERVIR-E&SA dedicated the MODIS antenna they installed on their premises. The antenna was funded by Google.org, the charitable arm of Google.
- SERVIR CO, hub, and USAID and NASA leadership personnel attended the 14-18 July Esri International User Conference in San Diego, California, and held a SERVIR mid-term evaluation on 13 July 2014 to discuss hub accomplishments, project status, and challenges. At the Esri User Conference, the SERVIR CO presented the SERVIR story via a NASA hyperwall presentation prepared by the SERVIR team (Dauna Coulter, Kathleen Cutting, Africa Flores, Tony Cole). Also at Esri, ICIMOD received a special achievement award for their vision, leadership, hard work, and innovation in use of geospatial technology.
- ICIMOD Director-General David Molden and Director of Strategic Cooperation Basanta Shrestha visited NASA Administrator Charles Bolden at NASA Headquarters 18 July 2014 to discuss SERVIR-Himalaya status. NASA tweeted photos of the visit and links to the SERVIRGlobal.net story about the visit to the Agency's 7 million twitter followers. US Ambassador to Nepal Peter Bodde, NASA Earth Science Division Director Michael Freilich, and NASA Deputy Associate Administrator for International and Interagency Relations Al Condes also participated in discussions with the two guests from ICIMOD.
- Lee Stewart and Africa Flores attended training on Monitoring & Evaluation (M&E) in Arusha Tanzania 30-31 July conducted by DAI and TRG. There were approximately 24 people in attendance, including Stewart, Flores, and three Demand Team members. The participants from RCMRD were made up of a mix of personnel from both SERVIR and RCMRD Institutional staff offices. The main objective was to familiarize the people with M&E and its purpose as related to USAID, specifically to establish a common set of definitions and delineate the differences between monitoring and evaluation.
- Dan Irwin presented at the U.S. – Africa Leaders Summit in Washington, DC, 4 August 2014. This was the first such event of its kind, intended as an opportunity to discuss ways of stimulating growth, unlocking opportunities, and creating an enabling environment for the next generation of Africa.
- SERVIR-Mekong Hub Coordinator Sean Austin visited the SERVIR CO 6-8 August 2014 for information gathering to prepare for his new role.
- Eric Anderson gave a SERVIR presentation at the NASA Annual Earth Science Applications Showcase and participated in Global Earth Observation System of Systems (GEOSS) in the Americas Earth Observations to Benefit Society event for embassies from countries in the Americas that are in DC (e.g., the Guatemalan embassy to the US in DC, the Colombian embassy to the US in DC., etc), at NASA Headquarters, 5-7 August 2014.
- Anderson traveled to El Salvador, Costa Rica, and Panama to support SERVIR AST member Alan Blackman 10-16 August 2014. The pair reached out to potential end users for the tool Blackman is developing for identifying the most valuable sites, in terms of REDD+ criterion, to protect from deforestation. Blackman and his team have created a preliminary version of a Forest

Conservation Targeting Tool (FCTT) that assigns "weights" to user-defined forested areas that reflect their relative worth in terms of conservation benefits. Decision-makers can use the tool to quantify and visualize the returns expected from protecting specific forested regions and, based on that information, select the best areas for conservation. Although the SERVIR Applied Sciences FCTT effort has focused first* on Mexico, the tool now covers all of Mesoamerica and the Dominican Republic and will be available in the future to interested end users in those regions. (See section 5.1.2 for more information.)

- Ashutosh Limaye attended a Lower Mekong Initiative Workshop on Cyberinfrastructure and Water Resources in the Lower Mekong Region 18-22 August 2014 in Hanoi, Vietnam. The event brought together scientists in water-related research disciplines and their network support staff from the Lower Mekong region (including Cambodia, Laos, Myanmar, Thailand and Vietnam) and scientists and network experts from the United States to
 - raise awareness among scientists and researchers in the Lower Mekong Region of the opportunities available for enhancing the region's ability to respond to the impacts of climate change by exploiting network-enabled collaboration opportunities
 - establish and strengthen research relationships, resulting in increased scientific collaboration
 - provide training in network skills and techniques to the scientists' institutions' network staff to enhance opportunities for collaboration
- Dr. M. Monowar Hossain, Executive Director of the Institute of Water Modelling (IWM) in Bangladesh, and Zahir-ul-Haque Khan, Director of the IWM Coast Port and Estuary Management Division, visited the SERVIR CO at NASA Marshall Space Flight Center in Huntsville, Alabama, 22 August 2014. They spoke at a special seminar about water-related problems the small, densely populated country of Bangladesh faces, and how IWM seeks to manage these problems.
- Also in August, NASA, USAID, and the US State Department held introductory meetings with the Israeli Development Agency (MASHAV) about MASHAV support for SERVIR through training activities related to water management and agriculture. All parties were very interested, and more discussions will be held.
- Gwen Artis traveled to Nairobi 1-5 September 2014 to meet with management from RCMRD and the SERVIR-E&SA team to review and confirm new task requirements resulting from a project-wide review; assess the impact to budget, schedule, and overall capacity to complete all hub activities; and address any necessary modifications to the RCMRD NASA SERVIR contract to reduce the risk of having unused expiring funds.
- SERVIR's Dan Irwin, Ashutosh Limaye, Eric Anderson, and Africa Flores represented SERVIR at the NASA Applied Science Strategic Implementation Retreat, Washington, DC, 9-11 September 2014.
- SERVIR hosted a display at Frontiers in Development (www.usaid.gov/frontiers) - a USAID event at the Ronald Reagan Building in Washington DC 18-19 September 2014. The event drew approximately 600 people, with keynotes from Secretary of State John Kerry, White House counselor John Podesta, USAID Administrator Rajiv Shah, high-level African leaders, and others.
- The SERVIR AST held its annual meeting at the CO on 22-24 September 2014. In addition to PIs and co-Is, SERVIR hub leadership and team members and USAID (Albert Anoubon-Momo) and NASA Applied Sciences leadership (Nancy Searby) attended. SERVIR AST projects' progress and hub projects' progress, next steps, and collaborations as well as broader NASA Applied Sciences Program vision and direction were discussed.
- SERVIR's Francisco Delgado presented at the Latin American Geospatial Forum in Mexico City, 22-25 September 2014. He gave an overview of SERVIR activities in hub regions, with emphasis on Latin America. He discussed what SERVIR does to promote capacity building for using

geospatial information in decision-making. The audience was made up of government institutions and agencies from across Latin America related to land management, environmental management, and mapping.

- SERVIR-Mekong hub organization selection was announced 3 October 2014. Kickoff will occur 30-31 October 2014 in Bangkok, Thailand, and capacity assessments will occur 3-5 November. The formal launch will be in January 2015.

6 Looking Ahead

We begin FY 2015 looking forward to the inauguration of our new hub in the Lower Mekong region of Southeast Asia. The hub partner organization is the Asian Disaster Preparedness Center (ADPC). NASA and USAID Washington are working to define respective responsibilities and roles in regard to this hub, and to identify the resources and science applications needed to build the capacity of decision-makers in the region to better deal with the demands of a changing climate by using Earth observations.

In FY 2015 for all of the SERVIR hubs, there will be greater integration of hub and AST projects to ensure increased uptake of available technology by the hubs and decision-makers. In addition, we will seek new collaboration opportunities within the broader NASA Applied Sciences Program and via the USAID Partnerships for Enhanced Engagement in Research (PEER) international grants program. These avenues will help us broaden the SERVIR portfolio to better meet the demands of new regions such as Lower Mekong and West Africa.

Other important activities planned for FY 2015 include two SERVIR AST-supported hub exchanges, one at SERVIR-E&SA in December 2014 and one at SERVIR-HKH in February or March 2015. Both events will introduce and offering training (in a train the trainer format) about an innovative tool for processing, publishing, and sharing Earth observation data. It is hoped that SERVIR-Mekong personnel will be able to attend at least one of the workshops along with the rest of the SERVIR team.

A SERVIR Summit is planned for 31 August – 4 September 2015 in Kathmandu, Nepal. This event will showcase SERVIR hub activities and applications, provide an opportunity for sharing expertise, and include special sessions such as thematic workshops and youth events.

Our team is ready for 2015 and beyond, as we continue connecting space to villages around the world.

7 Abbreviations and Acronyms

AAAS	American Association for the Advancement of Science
AAG	Association of American Geographers
ACC	African Conservation Centre
AERONET	Aerosol Robotic Network
AGU	American Geophysical Union
AOD	Aerosol Optical Depth
ARSET	Applied Remote SEnsing Training
AST	Applied Sciences Team
CATHALAC	Water Center for the Humid Tropics of Latin America and the Caribbean
CBFIIS	Community Based Forest-fire Information System
CEOS	Committee on Earth Observation Satellites
CERN	European Organization for Nuclear Research

CHAL	Chitawan Annapurna Landscape
CHIRPS	Climate Hazard Group InfraRed Precipitation with Station
CMAF	CPC Merged Analysis of Precipitation
CMAQ	Community Multi-scale Air Quality
CMIP5	Coupled Model Intercomparison Project Phase 5
CMORPH	CPC MORPHing technique
CO	Coordination Office
CoP	Community of Practice
CPC	Climate Prediction Center
CREST	Coupled Routing and Excess Storage
DEM	Digital Elevation Model
DHIS	District Health Information Software
DHMS	Department of Hydro-Meteorology Services
DIMS	Disaster Information Management System
DoFPS	Department of Forest and Park Services
DOI	Department of the Interior
DQA	Data Quality Assessment
DRR	Disaster Risk Reduction
DRSRS	Department of Resource Surveys and Remote Sensing
DSS	Decision Support System
DSSAT	Decision Support System for Agrotechnology Transfer
EAC	East African Community
E&SA	Eastern and Southern Africa
eCC	Electronic Country Clearance
EPA	Environmental Protection Agency
ESIP	Earth Science Information Partners
ESRI	Environmental Research Systems Institute
ESSI	Earth and Space Science Informatics (AGU)
ESSIC	Earth Systems Science Interdisciplinary Center
ETL	Extract, Transform, Load
EWX	Early Warning eXplorer
FEWS NET	Famine Early Warning System Network
FFWC	Flood Forecasting and Warning Center (Bangladesh)
FTP	File Transfer Protocol
FY	Fiscal Year
GBM	Ganges-Brahmaputra-Meghna
GCC	Global Climate Change
GEO	Group on Earth Observations
geolCT	Geographic Information and Communication Technology
GEOSS	Global Earth Observation System of Systems
GFW	Global Forest Watch
GHG	Greenhouse gas
GIS	Geographic Information Systems

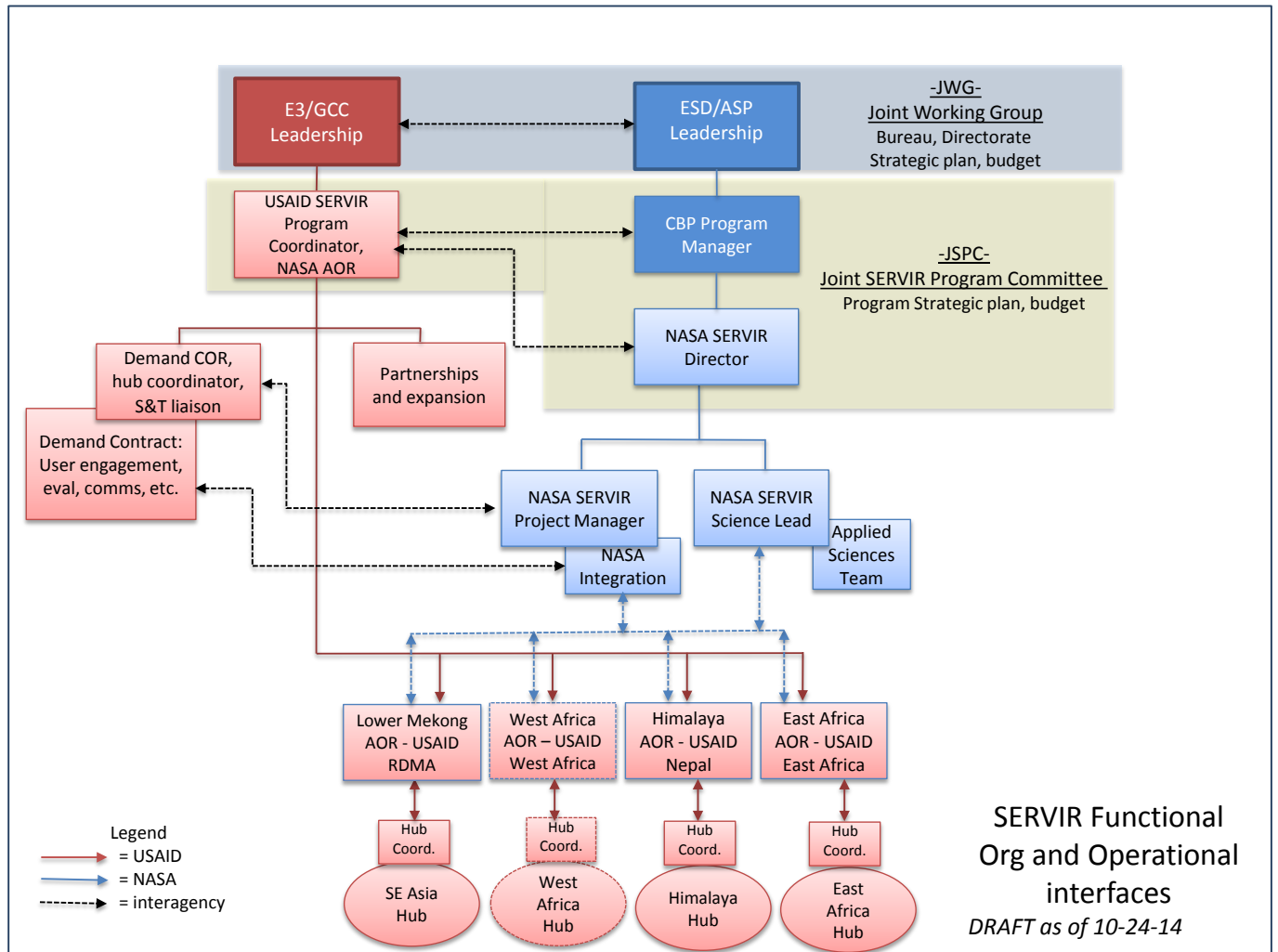
GIT	Geospatial Information Technology
GMAO	Global Modeling and Assimilation Office
GPCP	Global Precipitation Climatology Project
GPM	Global Precipitation Measurement
GSFC	Goddard Space Flight Center
HBV	Hydrologiska Byråns Vattenbalansavdelning
HCF	Health and Climate Foundation
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HKH	Hindu Kush-Himalaya
ICIMOD	International Centre for Integrated Mountain Development
ICPAC	Intergovernmental Authority on Development Climate Prediction and Applications Center
IDRC	International Development Research Centre
IDC	International Disasters Charter
IFAD-WRMF	International Fund for Agricultural Development Weather Risk Management Facility
IGAD	Intergovernmental Authority for Development
ILRI	International Livestock Research Institute
IMS	Integrated Master Schedule
INPE	Instituto Nacional de Pesquisas Espaciais
IPCC	Intergovernmental Panel on Climate Change
IR	Intermediate Result
IRI	International Research Institute
ISERV	ISS SERVIR Environmental Research and Visualization System
ISS	International Space Station
IT	Information Technology
ITAP	International Technical Assistance Program
IWM	Institute of Water Modeling (Bangladesh)
IWRM	Integrated Water Resources Department (Rwanda)
JPL	Jet Propulsion Laboratory
JWG	Joint Working Group
KDWR	Kenya Department of Water Resources
KIU	Karakoram International University
KMD	Kenya Meteorological Department
KML	Keyhole Markup Language
KMS	Kenya Meteorological Service
LandPKS	Land Potential Knowledge System
LCLU	Land Cover Land Use
LDCM	Landsat Data Continuity Mission
LiDAR	Light Detection And Ranging
LIS	Land Information System
LST	Land Surface Temperature
LVBC	Lake Victoria Basin Commission
MARC	Mountain Agricultural Research Centre
MARN	Ministry of Environment and Natural Resources

MENRIS	Mountain Environment and Natural Resources Information System
MFR	Matched Filter Regression
MoAD	Ministry of Agricultural Development (Nepal)
MoAF	Ministry of Agriculture and Forests MoAF
MOD-DRFS	MODIS Dust/black carbon Radiative Forcing in Snow
MODIS	Moderate-resolution Imaging Spectroradiometer
MODSCAG	MODIS Snow Covered Area and Grain size
MoEA	Ministry of Economic Affairs, Bhutan
MoHA	Ministry of Home Affairs
MOU	Memorandum of Understanding
MREDD	Mexico's Reduced Emissions from Deforestation and Degradation
MyCOE	My Community Our Earth
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESFF	NASA Earth and Space Science Fellowship
NGIC	National Geospatial Information Committee
NHS	Namibia Hydrologic Services
NNME	National Multi-Model Ensemble
NOAA	National Oceanic and Atmospheric Administration
NPP	National Polar-orbiting Partnership
NRSC	National Remote Sensing Centre, India
NSDI	National Spatial Data Infrastructure
NWS	National Weather Service
OFDA	Office of U.S. Foreign Disaster Assistance
OGC	Open GIS Consortium
PERSIANN	Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks
PI	Principal Investigator
PMP	Performance Management Plan
POO	Payload of Opportunity
RCCP	Regional Climate Change Program
RCMRD	Regional Center for Mapping of Resources for Development
REDD	Reduced Emissions from Deforestation and Degradation
REMA	Rwanda Environmental Management Authority
ROSES	Research Opportunities for Space and Earth Sciences
SBA	Societal Benefit Areas
SDI	Spatial Data Infrastructure
SID	Society for International Development
SMAP	Soil Moisture Active-Passive
SPARRSO	Space Research and Remote Sensing Organization
SPoRT	Short-term Prediction Research and Transition Center
SRTM	Shuttle Radar Topography Mission
SST	Sea Surface Temperature
SWAAT	SERVIR Water Africa-Arizona Team

SWAT	Soil and Water Assessment Tool
SWOT	Strengths, Weaknesses, Opportunities, Threats; Surface Water Ocean Topography
TAB	Technical Advisory Board
TDR	Tropical Disease Research
TMA	Tanzania Meteorological Agency
TNC	The Nature Conservancy
TRFK	Tea Research Foundation of Kenya
TRMM	Tropical Rainfall Measuring Mission
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN ILO	United Nations International Labor Organization
UNISDR	United Nations International Strategy for Disaster Risk Reduction
UNOOSA	United Nations Office for Outer Space Affairs
US	United States
USAID	United States Agency for International Development
USDA-ARS	US Department of Agricultural Research Service
USFS	United States Forest Service
USG	United States Government
USGEO	United States Group on Earth Observations
USGS	US Geological Survey
VDC	Village Development Community
VIC	Variable Infiltration Capacity
WBS	Work Breakdown Structure
WFP	World Food Program
WGCapD	Working Group on Capacity Building & Data Democracy
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting
WRMA	Water Resources Management Authority
WRSI	Water Requirement Satisfaction Index
WSN	Wireless Sensor Network
WWF	World Wildlife Fund

APPENDICES

Appendix A: SERVIR Organizational Chart



Appendix B: SERVIR Satellites/Sensors Used

Satellite Name	SERVIR Projects Using Data
ALOS (Japanese) (PALSAR data)	1*
AMSR-E on Aqua	3*
ASAR (European) Envisat satellite	1
ASTER	3
EO-1 Visible Imagery, 30-m	1
GRACE	2
ICESat (GLAS)	1*
Jason-2	1
LANDSAT 5* and 7	8
LANDSAT 8	1
Meteosat	2
QuikSCAT	1*
SMOS	1
Terra and Aqua- MODIS	18
TRMM	10
VIIRS	**
GPM (Launched Feb 2014)	8
Current Use of NASA Products	
LIS	4
SRTM	8
Current Use of Commercial Satellites	
GeoEye	1
IKONOS	1
Radarsat-2	3
Future Use of Satellites/Sensors	
AltiKa (Launched 2013) AST adding to Jason-2 system	1
ICESat-2 (Launch sched 2017)	1
Jason-3 (Launch Sched 2015)	1
SMAP (Launch sched Nov 2014)	3
VIIRS (AST task sched Dec 2014)	8

* Satellite/sensor no longer producing data

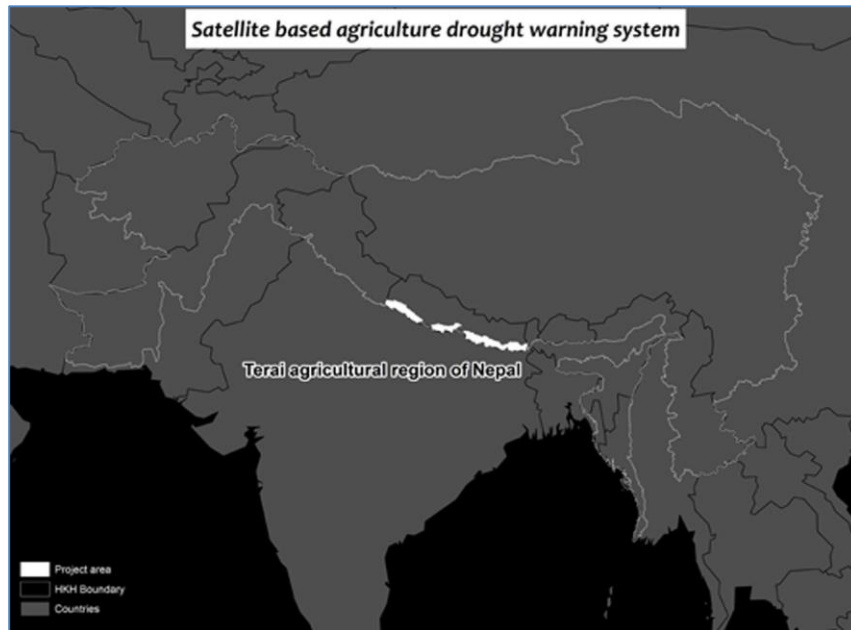
** SERVIR product in progress

Appendix C: SERVIR Project Geographic Extent Maps

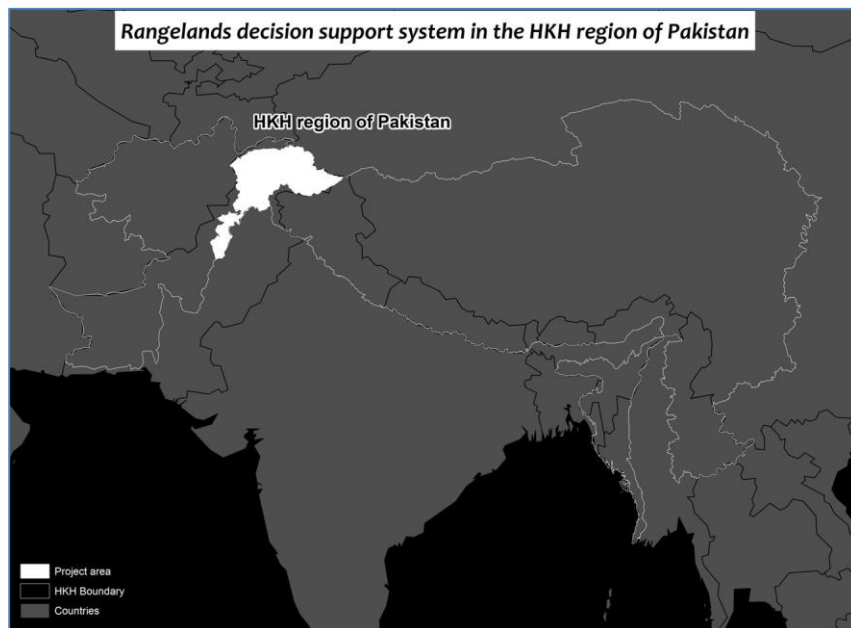
Agriculture and Food Security

SERVIR-Himalaya

Satellite-based Agricultural Drought Early Warning System



Rangelands Decision Support System (DSS) for the HKH Region of Pakistan

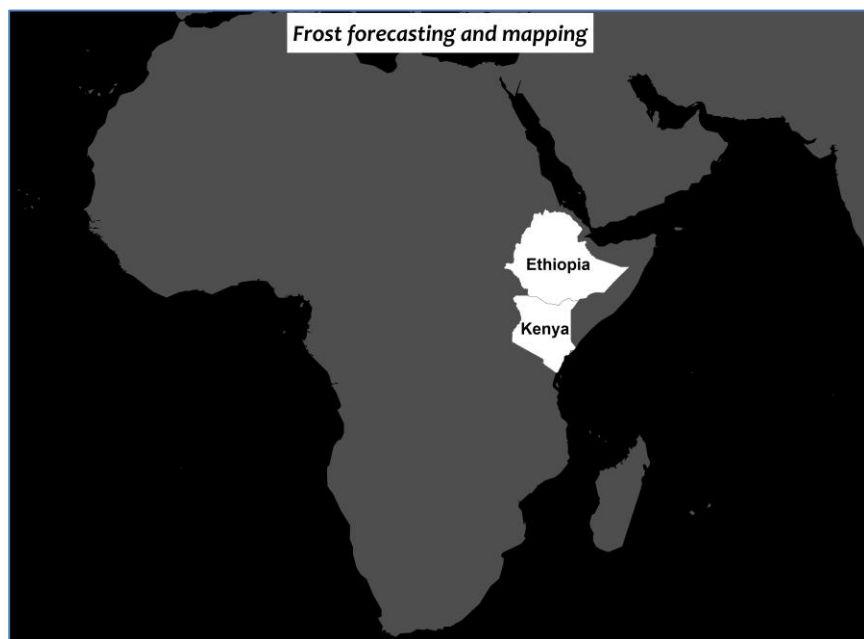


SERVIR-E&SA

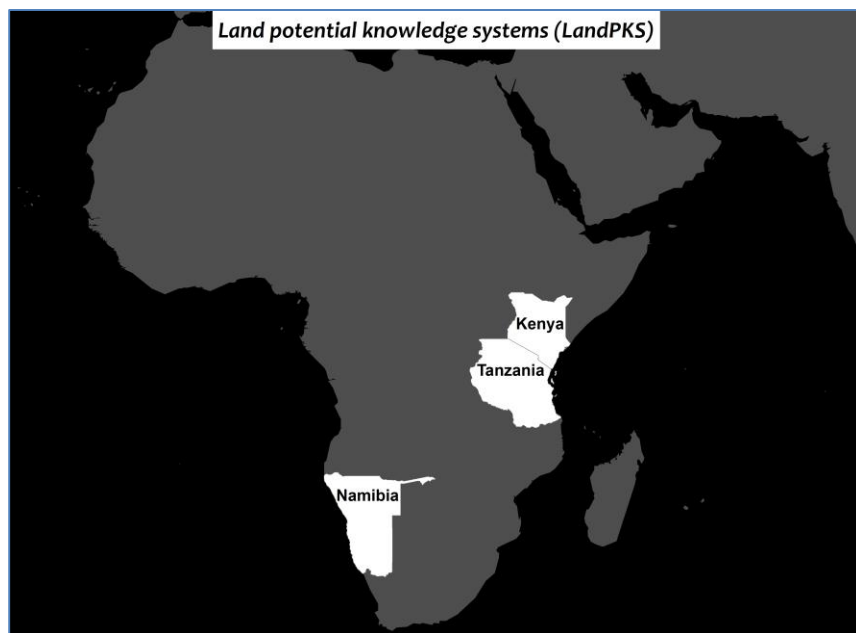
East Africa Drought and Agricultural Productivity Assessment and Prediction System (Sister project: Crop Monitoring and Yield Forecasting)



Frost Forecasting and Mapping System



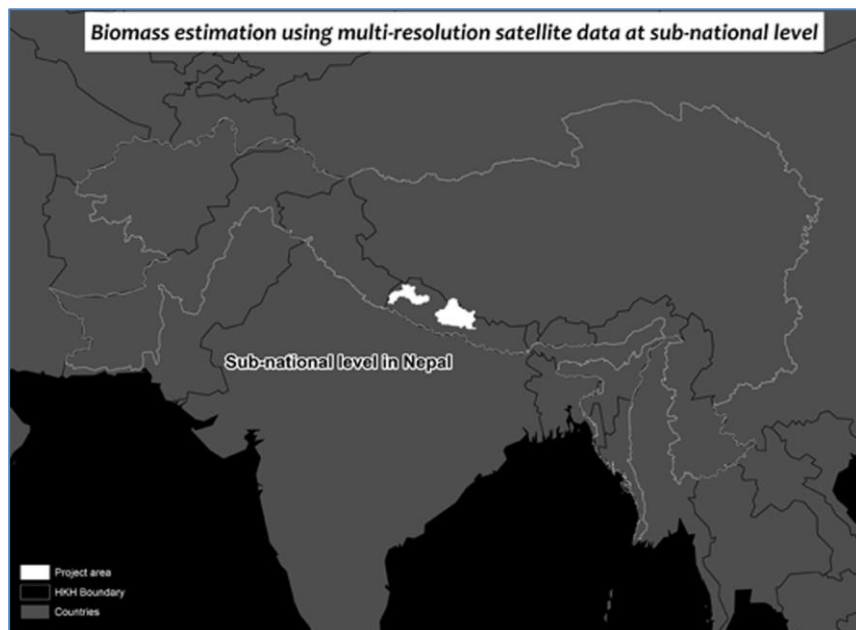
Land Potential and Knowledge System (LandPKS)



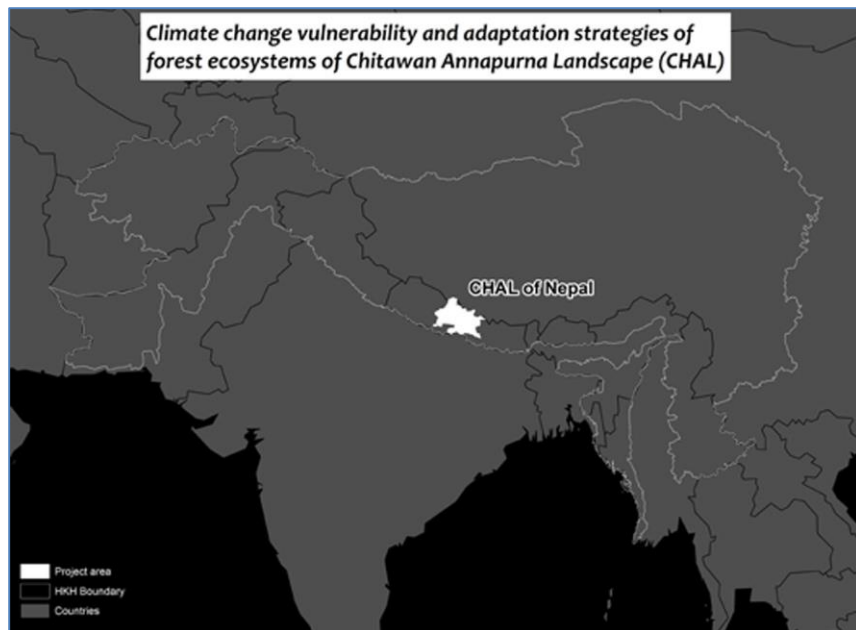
Ecosystems and Sustainable Landscapes

SERVIR-Himalaya

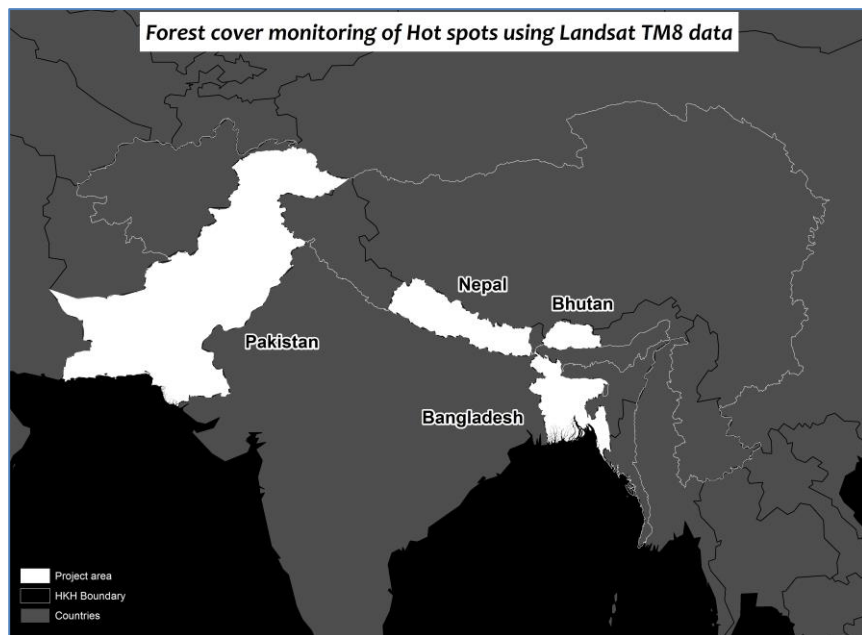
Biomass Estimation using Multi-resolution Satellite Data at Sub-national Level



Climate Change Vulnerability and Adaptation Strategies of Forest Ecosystems of Chitawan Annapurna Landscape (CHAL) of Nepal using Geospatial Approaches

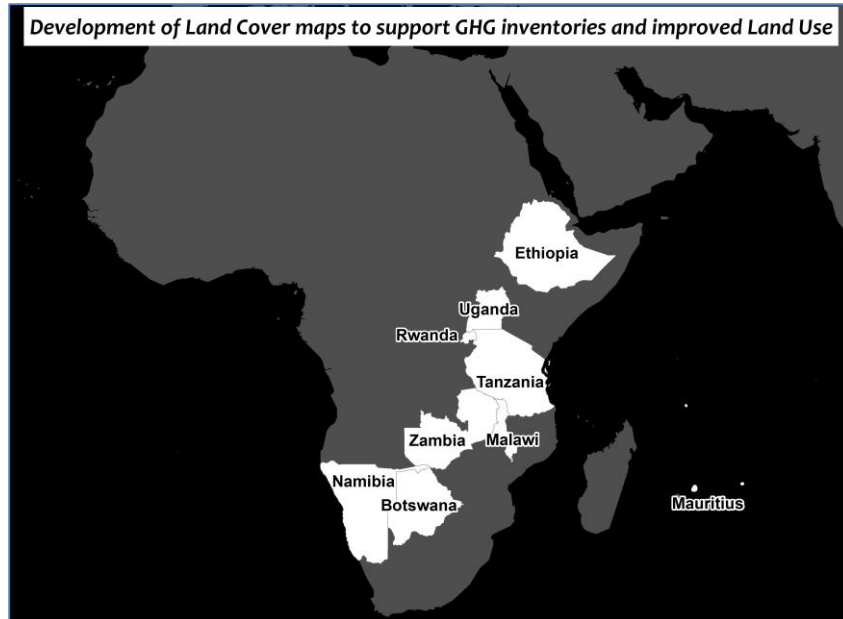


Automated Forest Cover Monitoring of Hot Spots using LANDSAT TM 8 data



SERVIR-E&SA

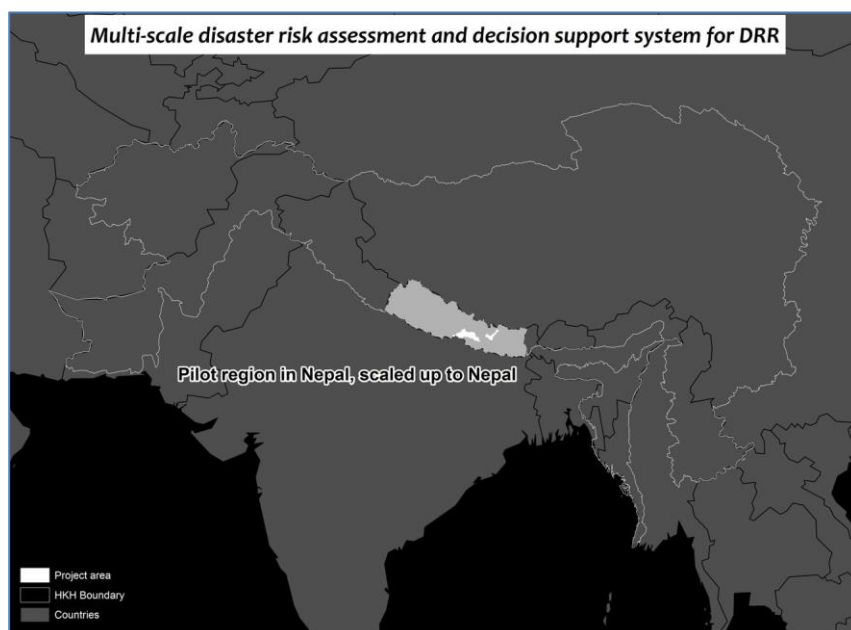
GHG Land Cover Mapping



Disasters

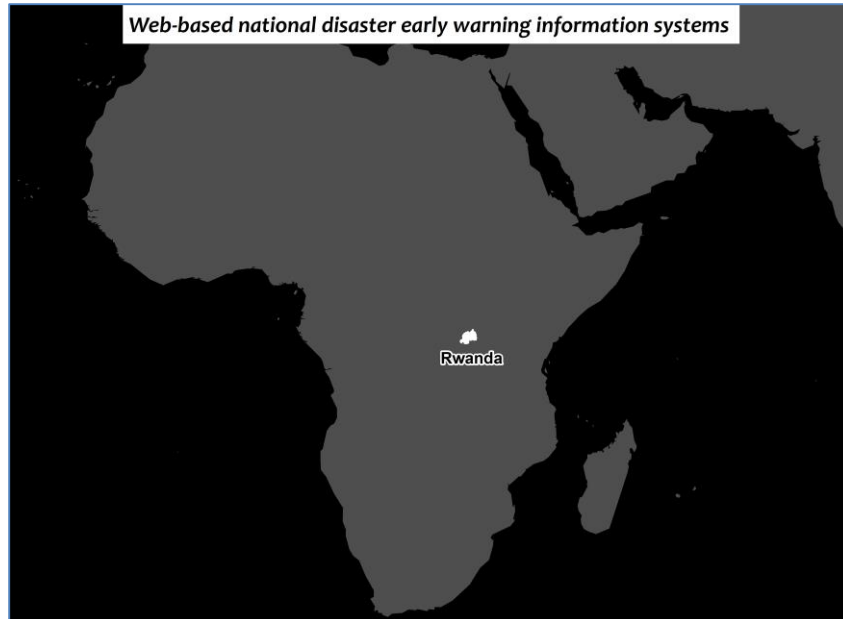
SERVIR-Himalaya

Multi-scale Disaster Risk Assessment and Decision Support System for Disaster Risk Reduction

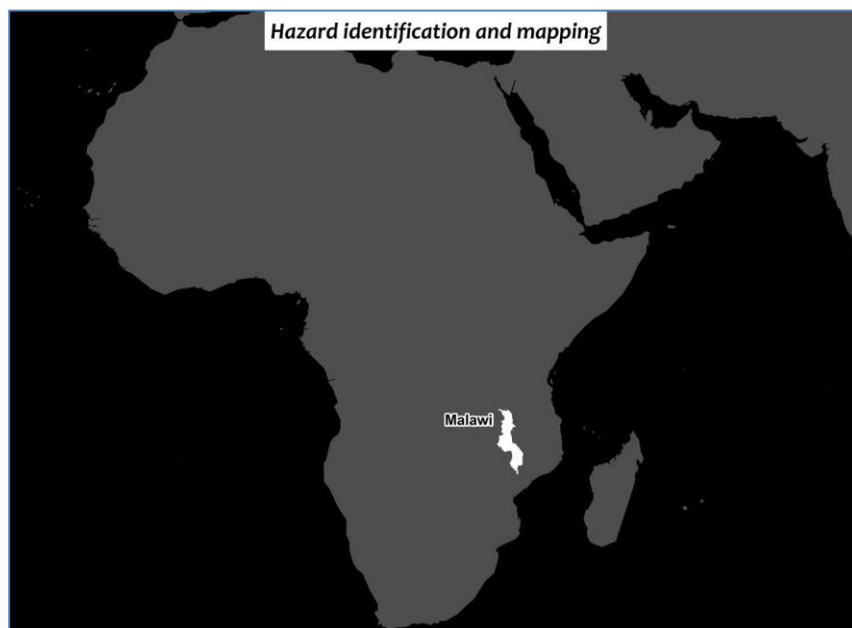


SERVIR-E&SA

Web-based National Disaster Early Warning Information System (Rwanda)



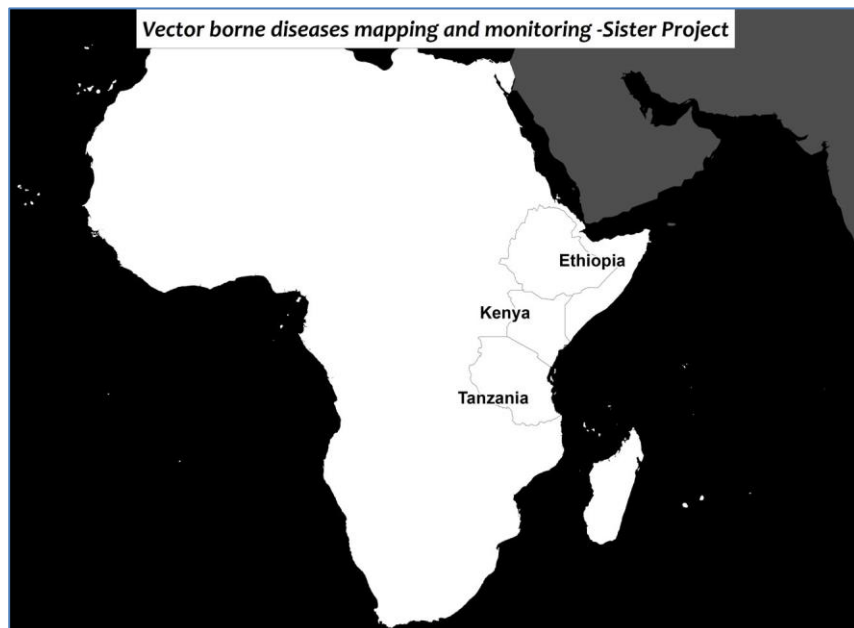
Hazard Risk Identification and Vulnerability Mapping (Malawi)



Health Information System (Zambia)



Vector-borne Diseases Mapping and Monitoring (sister project)



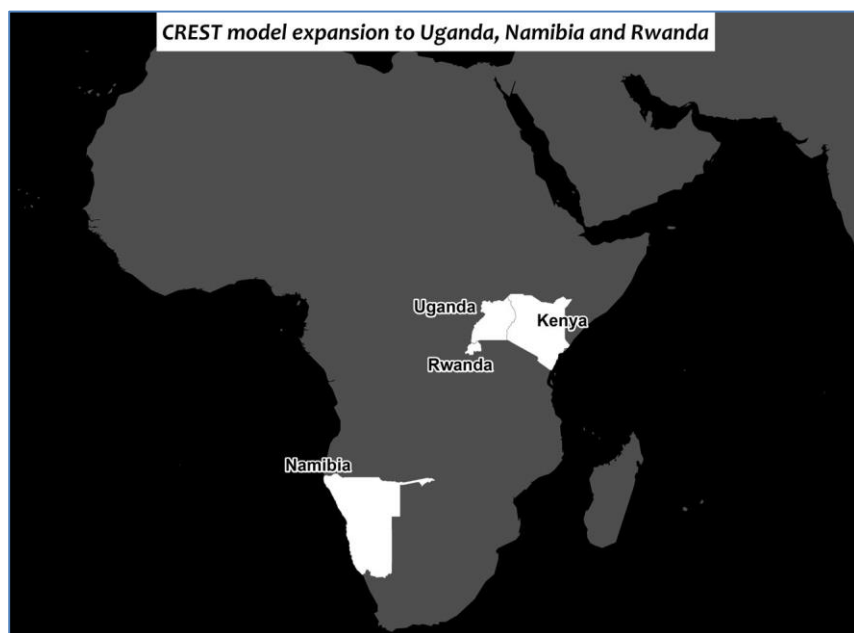
CREST-based Flood Mapping Tool



Water Resources and Cryosphere

SERVIR-E&SA

CREST Model Expansion to Uganda, Rwanda, and Namibia



Lake Victoria Water Quality and Ecosystem Management



Appendix D: SERVIR Deliverables Table (1 of 2)

	Tasks/Deliverables	Finish	POC	Hub	HUB SOW#
3.3.1.3.1.1	WSN data on temperature, humidity, and windspeed	10/8/2013	Limaye	CO	NA
3.3.1.3.1.2	Frost algorithm predictions of likelihood and severity of frost	10/8/2013	Limaye	CO	NA
3.3.3.2.2.1	Malawi Inception meetings/workshops	1/6/2014	Korme	RCMRD	2.3.1.2
3.3.3.1.2.9.3	Stakeholder workshop report	3/25/2014	Birendra	ICIMOD	5.4
3.3.2.1.2.7.3	Stakeholder workshop report	3/25/2014	Birendra	ICIMOD	2.2.2
3.3.2.1.3.9.2	Data on forest cover in hotspot areas	3/25/2014	Birendra	ICIMOD	2.2.3
3.3.1.2.1.7.1.1	Reports (training and workshops) 1	3/31/2014	Korme	RCMRD	2.1.1.1
3.3.1.2.1.2	Historical yield data for Uasin Gichu	3/31/2014	Korme	RCMRD	2.1.1.1
3.3.1.1.2.10.3	Stakeholder workshop report	4/23/2014	Birendra	ICIMOD	2.1.2
3.3.1.1.1.9.2	Stakeholder workshop report	4/28/2014	Birendra	ICIMOD	2.1.1
3.3.2.1.3.9.3	Stakeholder workshop report	4/30/2014	Birendra	ICIMOD	2.2.3
3.4.4.3.3	Hackathon event (report)	5/1/2014	Birendra	ICIMOD	4.2.3
3.3.3.2.1.2	Inception meeting/workshop report	5/12/2014	Korme	RCMRD	2.3.1.1
3.3.1.1.1.9.3	Stakeholder engagement strategy	5/14/2014	Birendra	ICIMOD	2.1.1
3.3.2.1.1.11.3	Biomass estimation stakeholder workshop report with engagement strategy	5/19/2014	Birendra	ICIMOD	2.2.1
3.3.1.1.2.10.4	Range Lands DSS in HKH Region of Pakistan Stakeholder engagement strategy	5/22/2014	Birendra	ICIMOD	2.1.2
3.1.2.1.2	2014 SERVIR CO PMP	6/3/2014	L. Stewart	CO	NA
3.4.2.3.1.1	Regional training on Disaster risk assessment	6/13/2014	Birendra	ICIMOD	4.1.2
3.3.3.1.2.9.2	MODIS level 2 data products	6/17/2014	Birendra	ICIMOD	5.4
3.4.4.5.1.1	Consultations with national agencies and donors	6/26/2014	Birendra	ICIMOD	5.5.1
3.3.1.2.1.7.1.2	Reports (training and workshops) 2 DSSAT training	6/30/2014	Korme	RCMRD	2.1.1.1
3.3.2.2.2.5	LULUCF web services incorporated in the RCMRD and SERVIR Interactive Mapper	6/30/2014	Korme	RCMRD	2.2.1.2
3.4.4.5.2.1.4	NGIC Technical Training Report	6/30/2014	Korme	RCMRD	2.7.1.3
3.3.2.1.1.11.4	Training report	7/30/2014	Birendra	ICIMOD	2.2.1
3.3.2.1.1.11.6	Regional training	7/30/2014	Birendra	ICIMOD	2.2.1

Appendix D: SERVIR Deliverables Table (2 of 2)

	Tasks/Deliverables	Finish	POC	Hub	HUB SOW#
3.4.2.1.2.2	Training report available for International training on crop modeling (DSSAT) to RCMRD and DRSRS staff (Univ of Georgia)	9/16/2014	Korme	RCMRD	2.6.1.1
3.4.2.2.2.5	Training report available for National training to support previous GHG countries (Malawi, Rwanda, Zambia, Namibia, Botswana, Tanzania), to include GHG visualiz. tool (In-country)	9/16/2014	Korme	RCMRD	2.6.1.1
3.4.2.3.2.2	Training report available for National trainings on the application of geospatial technologies in disaster risk reduction in Rwanda, Zambia, Malawi, and Namibia (In-country)	9/16/2014	Korme	RCMRD	2.6.1.1

Appendix E: Performance Monitoring (Indicator Results) Table (1 of 2)

Appendix - 2014 Indicator Results vs Targets

Indicator Description	Summary of Accomplishments	Indicator Values		Variance	Variance %	Variance discussion (if 10% or greater)
		2014 Target	2014 Actual			
Indicator 1-1 Number of stakeholders using climate information in their decision-making as a result of USG assistance	Himalaya - Improved decision-making process since national governments operationally use forest cover monitoring system over hot spots and flood monitoring info is in use in Bangladesh Africa - Increased the number of stakeholders using the CREST model to minimize the impacts of climate change as a result of destructive floods through early warning and risk reduction	180	163	-17	9%	Not required
Indicator 1-2 Number of stakeholders receiving training as a result of USG assistance	15 major workshops held in FY 2014; over 400 stakeholders trained Africa - Use of GIS and Earth observation technologies for Disaster Risk Reduction in Africa CO - GIT Boot Camp Himalaya - Bhutan GIS Users Conference	344	427	83	24%	Bangladesh Youth Forum and Kathmandu Hackathon events held by ICI-MOD this year were not factored in original target number.
Indicator 1-3 Number of institutions engaged in regional or global knowledge exchange through SERVIR	Over 35 exchanges/workshops held in FY 2014; over 130 institutions engaged Africa - Inception meeting/workshop CO - AST annual review in Huntsville (September) Himalaya - Biomass estimation using multi-resolution satellite data at sub-national level regional workshop event	108	159	51	47%	Participation in Biomass Workshop and several other workshops/exchanges was greater than originally estimated due to better outreach efforts on the part of ICI-MOD.
Indicator 2-1 Number of data layers standardized and made accessible	Over 50 data layers added in FY 2014 Africa - crop monitoring and CREST apps CO - WSN related products Himalaya - MODIS-related products	126	59	-67	-53%	Delays in efforts associated with NGIC effort in RCMRD led to the delay of over 60 potential layers being added. Completion in FY 2015.

Appendix E: Performance Monitoring (Indicator Results) Table (2 of 2)

Appendix - 2014 Indicator Results vs Targets

Indicator Description	Summary of Accomplishments	Indicator Values		Variance	Variance %	Variance discussion (if 10% or greater)
		2014 Target	2014 Actual			
Indicator 2-3 Number of climate mitigation tools developed with USG help	Over 20 tools were developed or modified during FY 2014 Africa - LCLU tools Himalaya - Multi-scale disaster risk assessment and decision support system tools for DRR CO - Frost algorithm predictions of likelihood and severity of frost	25	21	-4	-16%	Delays in hiring trained personnel to perform RCMRD's task on Mapping Seagrass, Mangrove Forests & Coastal Erosion Hotspots is primary reason for variance from target. It will be achieved in 1st Q. of 2015.
Indicator 3-1 Funding leveraged from public and private sources as a result of USG assistance (\$M)	Not reported or targeted for this year	0	0	0	0%	Not required
Indicator 3-2 Number of scientists or decision-makers participating in exchanges between SERVIR hubs or partner institutions	130 scientists and decision-makers participated in tech exchanges Africa - National Geo-information Committees (NGICs) meetings held Himalaya - Climate change vulnerability and adaptation strategies of forest ecosystems of Chitawan Annapurna Landscape (CHAL) of Nepal using geospatial approaches CO - Annual AST review exchange in Huntsville	132	130	-2	-2%	Not required
Indicator 3-3 Number of institutions with improved capacity to address climate change issues as a result of USG assistance	Over 90 institutions with improved capacity during the past year Africa - NGICs meetings held Himalaya - Climate change vulnerability and adaptation strategies of forest ecosystems of CHAL of Nepal using geospatial approaches CO - Annual AST review exchange in Huntsville	167	99	-68	-41%	Overly optimistic targets set by RCMRD with regard to GHG expansion this year as well as a miscalculation on timing of SDI rollout and effects. (Targets will be reviewed for 2015.)

